SCIENTIFIC AMERICAN

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THE WESTINGHOUSE INTERLOCKING SWITCH AND SIGNAL SYSTEM.

Some weeks ago we illustrated the electro-pneumatic block system of train signaling. In our present issue we present our readers with illustrations of some of the salient points of the Westinghouse interlocking switch and signal mechanism for use in train yards. It includes three operating agencies, electricity, pneumatic pressure, and hydraulic pressure. The work of throwing switches and of setting signals at safety is done by pneumatic pressure. The valves for regulating its action on signals are worked by electricity exactly as in the block system already described. The valves for regulating its action on switches are moved by hydraulic pressure.

Referring to the perspective view of the switch board, it will be seen to be a case upon whose front are two rows of handles. These handles, when moved by the operative, turn through an arc of a circle long vulcanite-covered spindles that run to the back of the case. These spindles are numbered in pairs; of similar numbers, those to the left are rotated by the lower handles, those to the right by the upper handles. On the rear end of each spindle is a quadrant with locking detent, worked electrically. The upper row of handles operates the switches; the lower row operates the signals.

At the rear of each switch spindle, that is to say of every second one, is a three-way cock attached directly to the spindle, and therefore turned by the upper handle appertaining to the spindle in question. This cock is a part of the hydraulic system. Turned to the right, it operates by hydraulic pipe connections a valve in the neighborhood of a switch which may be a mile or more distant. The operation of this valve, which is connected to pneumatic pipes, admits compressed air to the actuating cylinder and piston, and throws the switch in one or the other direction. The switch-throwing mechanism will be described later on.

When a current of electricity is passed through the actuating magnet of the signal-moving mechanism, Fig. 3, which also may be at any distance, it opens a pneumatic valve, admitting air to the signal-actuating cylinder, placed on the semaphore post. The piston is forced outward and the semaphores are depressed to the safety position. This current is sent through the switch board, when the handles are set in proper position therefor. On each of the vulcanite-coated spindles are placed strips of platinum, and between the spindles are pairs of contact springs. These, with their connections, can be arranged in any way whatever to suit the conditions of the case. The circuit, including the semaphore magnet, is completed through one or more of these spindle connections. Hence the setting of any given semaphore at safety may be made to depend upon one or more switch movements, as necessary. After the switch handles in its series are properly set, they complete their part of the circuit by means of the platinum strips and springs. Then the final turn of the signal handle moves its spindle into position and the circuit is completed, and the semaphore descends to "safety." When the switches are to be changed, the signal circuit has first to be broken. This permits the air valve to close automatically, and the semaphore rises by the influence of its counterweights to "danger." The switches can then be moved as required. At the bottom of each signal-moving mechanism Fig. 3, is a circuit closer. This keeps a circuit closed as long as the semaphore is at danger. It is an independent circuit and works the locking of one of the quadrants on the rear of the signal handle spindles.

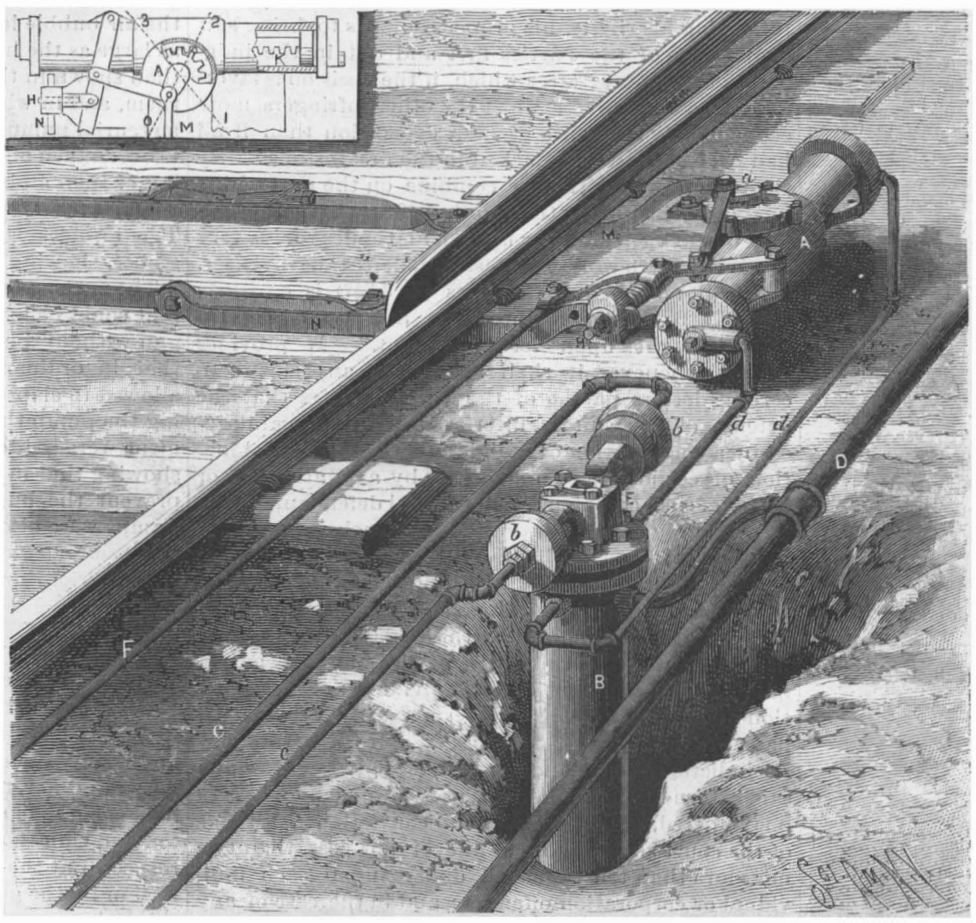

Fig. 1.—AUTOMATIC SWITCH-OPERATING MECHANISM.

This, in connection with our former article, is enough to show how the signals are operated. The switch-throwing mechanism has now to be described. This is placed by the side of the track, near the switch. It is shown in Fig. 1. The hydraulic tubes, *c c*, connect with two cylinders, *b b*, and force the pistons one way or the other, according to the position of the three-way cock in rear of the switch board. At B is a reservoir, kept charged with compressed air by the regular air pipe, D. At E is a D-valve, exactly such as used in a steam engine, and which admits the compressed air into either one of the pipes, *d d*, and puts the other one of these pipes in communication with the open air. At A is a double cylinder with two pistons, connected by a rack and working a pinion. The partial section is shown in the upper left hand corner of the cut, in which K is the rack and A is the pinion. The air admitted by one of the pipes, *d d*, forces the pistons in one or the other direction, regulated by the D-valve, thus turning the pinion. As the pinion turns it carries around with it an arm attached to its spindle, *a*. In its revolution through about three-quarters of a circle the pinion has to successively perform the following operations: 1. To withdraw the locking bolt, H, from the hole in the locking bar, N; 2, throw the switch, by moving the rod, M; 3, return the locking bolt, H, to the other hole in the locking bar, N.

Referring to the sectional view, H is the locking bolt, N the locking bar, and M is the switch rod. If air is admitted to the right hand end of the cylinder, the other end communicating with the open air, the pistons will move to the left. The movement of the pinion may be divided into three phases, indicated by the dotted lines. Moving from 0 to 1 it withdraws the lock bolt, but practically does not move the switch bar, or at least only back and forth through the versed sine of the arc described by the crank pin between 0 and 1. From 1 to 2 the relations are changed; here the switch rod is moved through a longer distance, corresponding to the chord of the arc, 1–2, throwing the switch, while the lock bolt is

(*Continued on page 279.*)

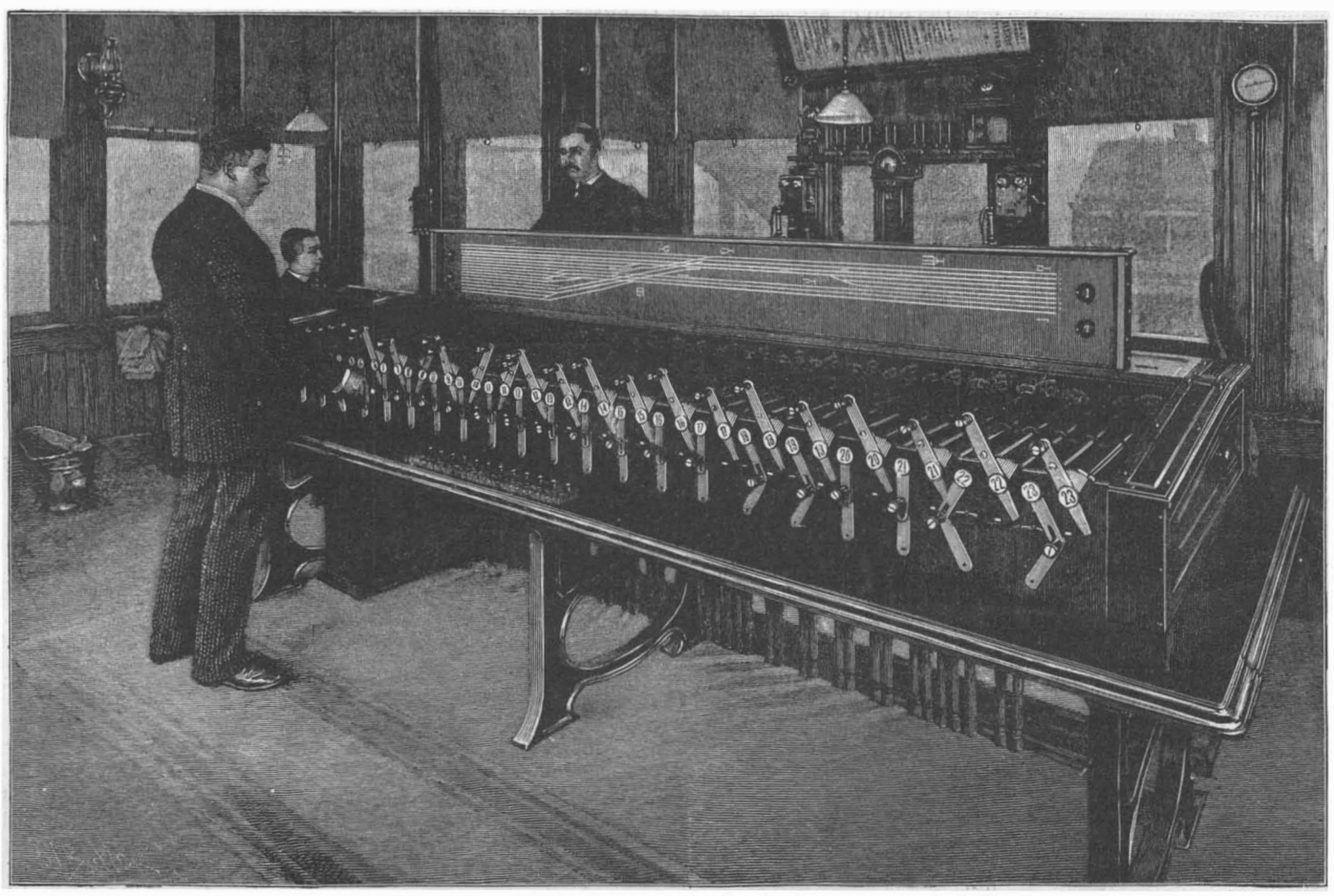

Fig. 2.—ELECTRO-PNEUMATIC INTERLOCKING SWITCH AND SIGNAL STATION AT PITTSBURG, PA.

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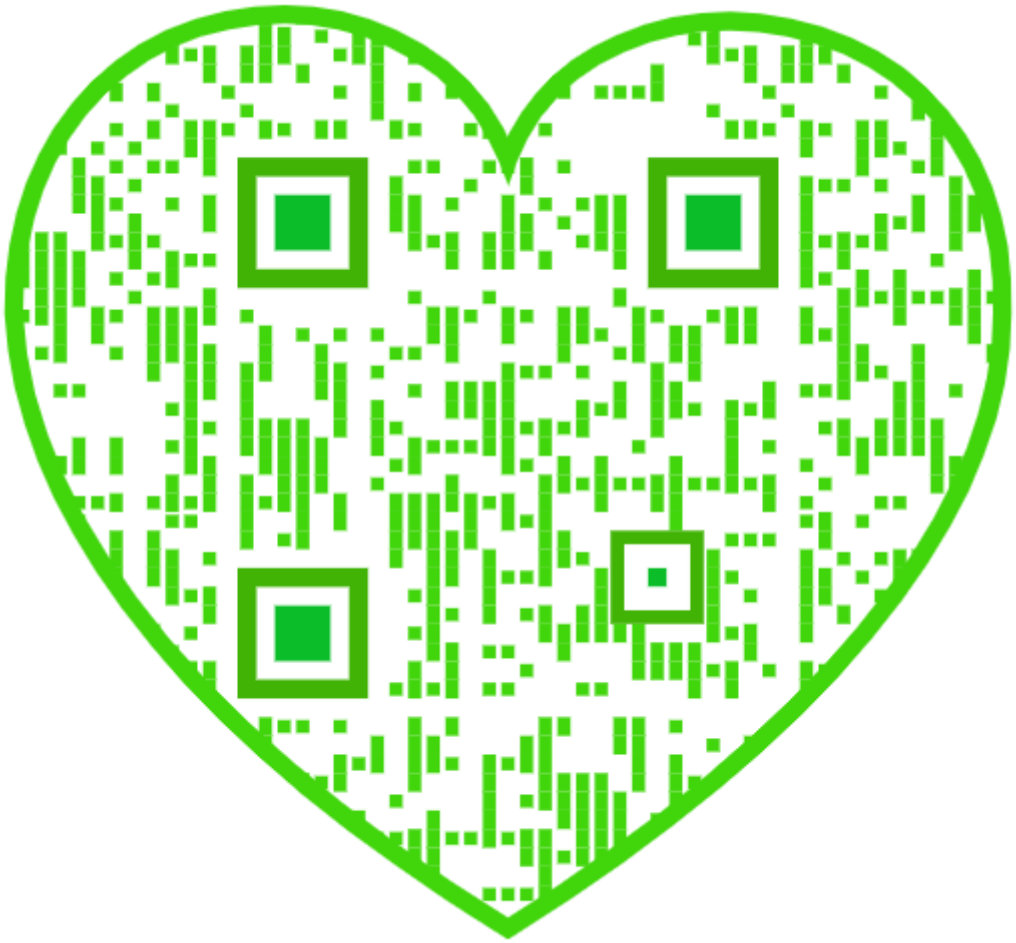

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A QUESTIONABLE PATENT BILL.

Many bills have from time to time been introduced in Congress, but not as yet passed, having for their object to crush the patentees of new inventions and benefit pirates and infringers, depriving patentees of the means of enforcing their patents and securing damages in the courts. It is, therefore, refreshing now to find a bill introduced in both branches of the national legislature which, ostensibly, is intended to protect the inventor.

It is common for wealthy corporations and others, who find infringements of patents to be profitable, to band together in supplying money and lawyers for their mutual defense. If, for example, John Doe, the inventor and patentee, finds several different parties infringing his rights, his proper course is to bring suit against one of the parties first and obtain the judgment of the court; after which, if the decision is favorable, he can proceed against the other infringers more economically and with greater expedition than if all had been separately attacked in the first instance. By the formation of a ring or combine on the part of the infringers they bring their united efforts to bear whenever one of their number is sued, and endeavor in every possible way to worry, harrass, and defeat the inventor. The bill now before Congress (S. 3,347) is entitled: "A bill to forbid maintenance and oppression in suits brought upon letters patent." It provides "That whenever it shall appear in any suit concerning letters patent of the United States that the defense of the suit is interfered with or maintained by a combination of individuals or by a combination of corporations, or both, or by any attorney or officer of such combination not lawful defendants thereto, originally or by intervention, any such interference or maintenance is hereby declared to be a public offense; and the attorney of the United States for the district where such action is pending shall, upon the affidavit of the plaintiff, supported by the affidavits of two other persons filed in the court where the suit is pending, naming such combination of individuals, or combination of corporations, or both, summarily present the names of all parties so complained of to a grand jury for indictment, and upon a bill of indictment found said attorney shall criminally prosecute each and every one indicted, and upon trial and conviction the judge of the court shall impose a fine of not less than two nor more than ten thousand dollars upon each individual or corporation offender; and in the case of any association or trust composed of individuals or corporation offenders, or both, the said United States attorney shall proceed in equity immediately after such conviction to dissolve such association or trust and to confiscate its property to the use of the United States, and circuit courts of the United States shall have original jurisdiction of this offense."

There is another aspect of the subject which makes it questionable whether this proposed law ought to pass: for while it might tend to assist the honest and humble inventor plaintiff, it might also be used with disastrous effect by a rich and powerful corporation plaintiff for the purpose of distressing and compelling the surrender of innocent defendants. For instance, it might be asked why such powerful and unconscionable monopolies as the Western Union Telegraph Company or the Bell Telephone Company should need the help of a special act of Congress like this, to prevent other people and other corporations from uniting against either of them for purposes of legitimate mutual defense.

Why should the law make it a crime for a poor defendant to call in aid for his defense while it regards as innocent the powerful plaintiff who does the same thing in the prosecution? Under this law the plaintiff is at liberty to make as many combinations with individuals and corporations as he chooses, and to use this combined strength against the defendant. This law, without any regard to the merits of the cause, makes saints of plaintiffs and sinners of defendants.

A New Vacuum Pump.

An exhibition of the vacuum pump of Mr. Adolp Berrenberg, of Somerville, Mass., was given recently in Boston. The pump is intended specially for use in producing the vacuum in the globes of incandescent electric lamps, and the exhibition was devoted entirely to this end, but the pump's usefulness does not stop here, since it may be applied wherever a perfect, or as nearly perfect, vacuum as it is possible to get may be required. Hitherto it has been impossible to get the required vacuum in the electric lamps without using the glass mercurial pumps, in which the falling of a column of mercury draws out the air with it. The Berrenberg pump, however, accomplishes better results without the use of mercury, and at the same time does the work very much more quickly than the best of the mercurial pumps. The principles of its operation are practically the same as with any piston vacuum pump. Its three exhausting cylinders are made air-tight by means of liquid under heavy pressure, a refined oil being the liquid used.

Exhibition of the power of the pump was first made in exhausting about 20 globes, this being a convenient number to handle, though it is claimed that only an extension of the apparatus would be required for a pump of this size to do the work on 500 or 1,000 at the same time. The globes were mounted on glass tubes, so that they could be easily sealed and taken from the pump. The greater portion of the air in the globes was taken out almost immediately, probably in two or three strokes of the pump, and the time taken subsequently was in producing the almost perfect vacuum needed in electric lighting. At the end of five minutes a couple of globes were sealed and taken from the pump and the bit of glass tube attached carefully broken off in a vessel of mercury, the result being a rush of the mercury to fill the vacuum in the globe and the consequent indication of the vacuum obtained. It was found that the air bubble left in these globes was only about twice as large as the head of a pin, a very much better result than shown in the lamps of the companies now making them, and in which the vacuum had been obtained by mercurial pumps only after three or four hours' time. Globes taken off in ten minutes showed a bubble hardly larger than a pinhead, and consequently a more perfect vacuum than had been obtained by any other process. The bubbles were also uniform in size in different globes, showing the steadiness of the operation.

The next experiment was to show how quickly the current could be let on to a lamp after exhaustion had begun without burning the carbon, it being explained that in ordinary manufacture at least one hour was allowed to elapse. In less than 30 seconds after starting the pump the half dozen lamps used in the experiment were lighted and burned steadily and brightly, showing that in that short time a vacuum sufficient to prevent the burning of the carbon had been formed. Lamps were also shown, still burning steadily, which had been burning for over 500 hours, this being to show the superior durability of the lamps exhausted by the pump.

The World's Fair in Chicago.

The bill authorizing and indorsing on behalf of the United States the holding of a World's Fair in Chicago in 1892-93 has finally passed both houses of Congress and received the signature of the President. Rivalry between different cities as to where the fair should be held some time ago ceased to be an element in the matter, and Chicago has been the unopposed leader in this respect, but the long delay in making the final authorization by the government had begun to lead people to think that possibly we were not to have any fair at all. Now, however, it is high time for the beginning of actual work, if we are to make the fair the national success it should be, and worthily representative of our position and progress in all the arts, sciences and industries.

The possibility of a high degree of success in such endeavor is, moreover, greatly increased by the fact that Congress has virtually given another year for preparation—that is, although there will be exercises commemorative of the landing of Columbus in October, 1892, the fair proper will not be opened until the spring of 1893. There is also added to the bill a section directing the holding of a naval review in New York harbor in April, 1893, and foreign nations are to be invited to send ships of war to join the United States Navy in rendezvous at Hampton Roads, Va., and proceed thence to take part in the review.

Electric Light Wires in Montevideo.

Early in March one of the electric wires at the corner of Calle 18 de Julio broke and fell on the road. Two horses in a market cart passing by were thrown down by the electric current the moment they touched the wire, which was giving out sparks as it lay on the ground, and the driver was thrown off his seat. A policeman attempted to clear the wire from the horses' "feet" with his sword, when he was immediately knocked down by the force of the electricity. He managed to get on his feet, but was again knocked down. Some of the lookers-on went and pulled him off the wire, and in doing so one of them was knocked down, but managed to save himself by rolling off the wire. Immediately afterward a tramcar drawn by three horses arrived, and all the animals fell on coming into contact with the wire. By this time the men of the electric light company appeared on the scene. One of them was for a time prevented by the police from touching the wire, but afterward one of them seized the wire with a tongs to try to cut it, and was at once thrown on his back; but the tongs fell from his hands and he was able to get up again. Some more of the company's men arrived shortly after, and the horses were rescued. The men then set about to repair the wire in order to get light in the Calle 18 de Julio and other streets that were in darkness all the time.

AN excellent and quick way to mend broken plaster casts and impressions is to paint the broken surfaces over two or three times with very thick shellac varnish, and at each application to burn out the alcohol over a flame. When the shellac is sufficiently soft, press the parts together, and hold in position till cool. It will be as strong as it was before broken.

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THE OIL WELL AT SOUTHBURY, CONN.

BY E. O. HOVEY.

Connecticut has had a peculiar history respecting mineral wealth. Many of the precious and baser metals have been found within her borders in sufficient quantities to lure men to spend thousands of dollars in mining and prospecting, but the deposits have always proved deceptive and unremunerative. Gold, silver, molybdenum, bismuth, nickel, arsenic, copper, iron, and lead, besides other minerals too numerous to mention, occur in many localities in the State; but, with the exception of the iron at Salisbury, Sharon, and Kent, the search for them has been disastrous to every one except the mineralogist, who has been well repaid for his labors.

Coal and oil also have received attention at the hands of eager enthusiasts. Many years ago a boring for coal was made with the diamond drill in the town of Durham, in the south central part of the State. When a depth of about 500 feet had been reached, and before the Triassic rocks had been pierced, the fruitless task was abandoned. Parts of the core from this boring may be found in many private collections in the State.

The occurrence of combustible black shales in the Pomperang Valley, in the west central part of Connecticut, led some enterprising individuals in 1831 to sink a shaft for coal about a mile west of the village of Southbury, New Haven County. Welsh miners were employed, who sank a shaft six feet square one hundred feet into the rock. At this depth drilling was begun, and carried on for some scores of feet deeper, with the crude apparatus of the day. The story goes that one morning, after a depth of 250 feet had been reached, the miners on descending the shaft encountered a quantity of gas, which ignited from their lamps and exploded. This accident and the increase of water stopped the work, no genuine coal having been found.

About twenty feet from this old shaft a company of Waterbury capitalists began to sink a well in September, 1888, being influenced by the legend of the old well, and by the presence of oil on the waters of a brook near by, to think that oil or gas might be struck by a deep boring. A complete plant from Bradford, Penn., with a twenty horse power engine, was put in, and with a gang of experienced oil well drillers from Bradford work was pushed forward rapidly. Black bituminous shales and red shales smelling of petroleum encouraged the company in their undertaking, and gave even the drillers sufficient faith in the success of the project to lead them to try to lease all the land in the vicinity. The oil fever, however, had struck the Southbury farmers, and no land could be hired. After a series of the mishaps common in the making of deep borings, the depth of 1,525 feet from the surface was attained. Last summer (1889) the job of reaming out the lower half of the well was undertaken; but after it had been partly done the tools were lost, and no work has been done since, though the company has not abandoned the idea of drilling below the 1,525 foot level.

The well is in the south central part of the Woodbury-Southbury outlier of the Connecticut Triassic area. An account of the geology of the region, with map, by Prof. W. M. Davis, of Harvard University, may be found in the "Seventh Annual Report of the United States Geological Survey," issued in 1889. The well intersects red and black shales, red sandstones and conglomerates, and two trap sheets, and at about 1,235 feet passes from the fragmental Triassic rocks into the highly crystalline gneisses and mica schists so widely distributed throughout New England. It is of interest to note that this is the first recorded instance of a boring which has pierced the Triassic rocks of this State.

At 1,250 feet free-milling gold and silver-bearing rock was struck, which assayed $10 worth of gold and $3 worth of silver to the ton, and the rock for ten feet above and twenty feet below this depth shows this amount or more of silver. If this rock occurs in considerable quantities, it would well repay the outlay necessary to mine it, and some of the oil well companies propose sinking a well with the diamond drill to obtain more definite knowledge of the strata and the occurrence of gold-bearing rock.

Speaking from geological premises, there is no chance whatever of obtaining either oil or gas from any boring here or elsewhere in Connecticut. The Triassic rocks are far above the strata which yield oil or gas in other States, while the crystalline rocks, which form the remainder of the State and are mostly of uncertain age, have been so highly metamorphosed that all volatile constituents like oil and gas—if ever there were any—have entirely disappeared from them.

A LOAN association in this city recently invited a number of persons to hear a speech by the celebrated English statesman Mr. Gladstone. It was a phonographic oration. That is to say, a phono-cylinder was produced, stated to have been just received from London, and when the cylinder was put through the phonograph machine a voice was heard, said to be Mr. Gladstone's. The message was short and rather dry. It related to self-help and thrift, both of which are very desirable qualities, according to Mr. Gladstone.

School of Industrial Art and Technical Design for Women.

At a reception held recently at the School of Industriol Art and Technical Design for Women, 134 Fifth Avenue, New York City, Miss Katherine Smith, a pupil and the "historian" of the school, read a paper which was in substance as follows:

When in the fall of 1881 a class of five was instructed by Mrs. Florence Elizabeth Cory in the principles of design and taught to apply them practically to industrial arts, then was first established the organization known as the "School of Industrial Art and Technical Design for Women." From that nucleus sprang the prosperous school which at present has upon its roll of membership 490 names, correspondent pupils inclusive, all of whom are striving to attain a degree of proficiency in their several departments of practical designing and industrial handicraft that will enable them to become self-supporting. Among these students are representatives of every State and Territory in the United States, several Canadian cities, and the Sandwich Islands. During the first two or three years lectures were given to the students by prominent artists and designers, but these were discontinued because the classes soon assumed such proportions that there was not room enough to accommodate all who wished to hear them.

Numerous invitations have been extended by manufacturers in New York and vicinity to visit their factories, and prizes amounting to several hundred dollars have been offered for various designs, and a variety of valuable art specimens presented.

Many designs have been made and sold to manufacturers since the establishment of the school. The work done has included carpets of all grades, oil cloths, linoleums, wall papers, stained glass, carved and inlaid wood panels, printed silks and silkalines, ribbons, upholstery fabrics, portieres, table linen of all kinds, calicoes, prints, awnings, lace, fan mounts, book covers, china, Christmas, Easter, and menu cards. Not only have orders have been filled for American manufacturers, but there have been sent to Leeds and York, England, patterns for ingrains, to Carlsbad, Austria, designs for china, to Dundee, Scotland, patterns for table linen and towel borders, to Japan, designs for printed and embroidered silks.

What the Best Judges Declare an Invention to Be.

The late Judge Hall, of the United States Circuit Court, says:

"An invention, in the sense of the patent law, means the finding out, the contriving, the creating, of something which did not exist and was not known before, and which can be made useful and advantageous in the pursuits of life, or which can add to the enjoyment of mankind.

"In other words, the thing patented must be new; and it must be useful to an appreciable extent, though the measure of that usefulness is not material. Any degree of utility appreciable by a jury is sufficient, upon the question of utility, to sustain a patent." (Conover *vs.* Roach, vol. iv. Fisher's Patent Cases, p. 16.)

And Judge Sawyer, late of the Supreme Court of the United States, defines invention in the following language:

"Invention is the work of the brain, and not of the hand. If the conception is practically complete, the artisan who gives it reflex and embodiment in a machine is no more the inventor than the tools with which he works. Both are instruments in the hands of him who sets them in motion and prescribes the work to be done. Mere mechanical skill can never rise to the sphere of invention. The latter involves higher thought, and brings into activity a higher faculty. Their domains are distinct. The line which separates them is sometimes difficult to trace; nevertheless, in the eye of the law, it always subsists. The mechanic may greatly aid the inventor, but cannot usurp his place." (Blandy *vs.* Griffith, vol. iii. Fisher's Patent Cases, p. 616.)

But while, as Judge Sawyer asserts, the boundary line between the domain of invention and mere mechanical skill is strictly drawn, yet some of the most valuable inventions have been so simple as to lead one to think that they were obvious, and did not rise to the dignity of invention.

Concerning the simplicity of invention, the late Judge Story, of the Supreme Court of the United States, remarks:

"The simplicity of an invention, so far as being an objection to it, may constitute its great excellence and value.

"Indeed, to produce a great result by very simple means, before unknown or unthought of, is not unfrequently the peculiar characteristic of the very highest class of minds." (Ryan *vs.* Goodwin, vol. i. Robb's Patent Cases, p. 729.)

It not infrequently happens that a sudden lucky thought gives a man a small (sometimes a large) fortune—the outgrowth of an important invention.

More than a quarter of a century ago, the late Judge Shipman of the United States Circuit Court of New York embodied the idea in one of his decisions:

"A subject matter to be patentable must require invention; but it is not necessarily the result of long and painful study, or embodied alone in complex mechanism. A single flash of thought may reveal to the mind of the inventor the new idea, and a frail and simple contrivance may embody it. Some inventions are the result of long and weary years of study and labor, pursued in the face of abortive experiments, baffled attempts, and finally reached after the severest struggles; while others are the fruit of a single happy thought." (Magic Ruffle Company vs. Douglas, vol. ii. Fisher's Patent Cases, p. 338.)

Other opinions, similar in purport, might be added; but these are sufficient to define what constitutes a patentable invention, which is important information for every inventor to know.

A Smokeless Powder.

A new explosive in the line of smokeless powder has recently been invented and patented by Sir Frederick A. Abel, of London, and Professor James Dewar, of Cambridge, England. The authors say:

The gelatinous explosives produced by combinations of nitro-cellulose and nitro-glycerine, with or without other ingredients, exert great disruptive force when they explode, and are, therefore, not suited for ammunition purposes.

The present invention relates to an improvement in the manufacture of such explosives whereby we moderate the force and rapidity of their explosion, giving it a propulsive instead of a disruptive character, so that they are adapted for ammunition purposes, the permanency of the compound without change being at the same time secured. For this purpose we combine tannin with the nitro-cellulose or nitro-glycerine, or with both in either of two ways. We either dissolve the nitro-cellulose—such as gun cotton or pyroxline—by any of the known solvents—such as acetone or acetic ether—and we add the tannin ingredient to the solution; or we first dissolve the tannin ingredient in the acetone or its analogue and use this solution as the medium of incorporation with the nitro-glycerine. We thus produce a compound which, when the solvent is eliminated by extraction with water or by evaporation, or both, is a tough, hard substance that can be granulated or otherwise treated for use as an explosive.

Instead of employing nitro-cellulose alone in forming the compound, as above described, we employ with it various proportions of nitro-glycerine, and we thus obtain a compound of soluble nitro-cellulose or of gun cotton (insoluble nitro-cellulose) with nitro-glycerine and tannin in a gelatinous condition, which may be rolled into sheets, drawn into wire, or otherwise treated for use as an explosive.

With the compounds produced as above described may be incorporated various proportions of oxidizing agents—such as nitrates of potassium, sodium, ammonium, and barium—and oxidizable substances—such as lamp black or graphite—and hydrocarbons—such as paraffine, vaseline, and naphthaline, cellulose, fatty oils, and fats or nitro-derivatives of hydrocarbons.

The proportion of tannin added for the purposes of our invention may be varied. In treating gun cotton alone we have found the proportion of ninety parts of gun cotton and ten parts of tannin to give good results.

In the case of a compound of gun cotton and nitro-glycerine we have employed the following proportions with advantage:

	Per cent.	Per cent.	Per cent.
Nitro-glycerine	55	35	40
Gun cotton	35	55	40
Tannin	10	10	20

Under the term "tannin" is to be understood any of the substances that are sold commercially under the name of "tannic acid." We prefer, however, to use gallotannic acid for the purpose of our invention.

Waste of Gas.

Chemist Martin, of the New York Board of Health, made an important statement before the Senate Investigating committee recently in relation to the comparative dangers of electric lighting and gas. He says that 10 per cent. of the gas manufactured in New York escapes from the mains into the earth and permeates the cellars and basements of the buildings and residences throughout the city. In addition to the injurious effect this has on the health of the city, it is also manifestly evident that there is great danger to life and property through explosions which must follow the introduction of gas into sewers and subways. The *Western Electrician* thinks one thousand million feet of gas contain more danger than the electric conductors in New York City, yet this is the amount, according to the same authority, but which is hard to believe, that leaked from the mains of the gas companies of this city last year.

DURATION OF LIFE IN NORWAY.—According to a recent work on longevity, published in Norway, the average duration of life in that country is 48·33 years for men, and 51·3 for women.

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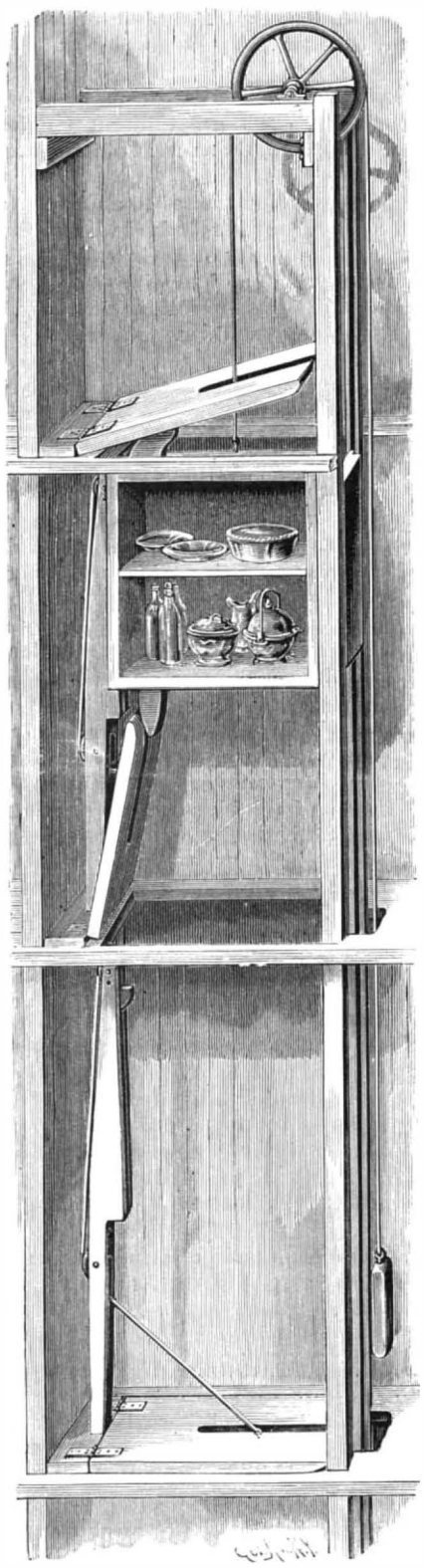
AN IMPROVED AUTOMATIC DUMB WAITER.

The accompanying illustration represents an improvement in hatchways, whereby an automatic opening of the hatches is effected by the cage as it ascends or descends, the hatches also automatically closing after the cage has passed. The invention has been patented by Mr. John Stoneham, of No. 58 Clinton Place, New York City, and is also applicable in the building and operation of freight and passenger elevators, as well as for dumb waiters, in which connection it is shown in the illustration. Between each pair of platforms in the hatchway is a grooved guideway, T-shaped in cross section, in which slides a stop, connected by a rope passing over pulleys, just under the floor above and at the side of the guideway, to the forward end of the hatch covering below. The lower portion of this guideway is not grooved, and has an offset beneath which the hatch cover is received when raised, so as to clear the cage. A flange of the stop slides in the cross groove of the guideway in a line slightly inclined from the vertical, the inclination being such that the stop is entirely concealed in the guideway when in its lowermost position, while projecting well out when in its uppermost position. The cage rising from below therefore pushes up the hatch cover and readily passes the stop, which it has first caused to drop to the lowermost position by the raising of the hatch cover, and then holds in until it has entirely passed it. The stop is then caused to press against the bottom of the cage by means of its rope and pulley connection with the hatch cover below, until the latter is entirely closed, when the stop will be in its uppermost position, and will project out of its grooved guideway to its entire extent. Upon the descent of the cage a beveled finger on its bottom bears upon the stop to push it down and gradually open the hatch below, as each succeeding opening is passed, the covers gradually closing over the cage as it goes down. It is obvious that the construction here shown presents great advantages in its perfectly automatic manner of closing as well as opening the hatches, whereby the great danger of fire from open shafts communicating with the different floors of a building is avoided. In the use of such construction, also, for freight and passenger elevators, with the application of power therefor in any of the ordinary ways, it is evident that many of the dangers incident to ordinary systems would be avoided, as the hatches would all be closed except the one which the car was at the time passing, and it would not be possible for a car to fall for any considerable distance from any carelessness of the attendant or the breakage of any of the parts, as it would be impossible for the automatic action by which the hatch covers are opened to take place with sufficient rapidity to allow a car to fall from the top to the bottom of a shaft.



STONEHAM'S AUTOMATIC DUMB WAITER.

J. G. Halske.

The death is recorded, at Berlin, of Herr Johann Georg Halske, the co-founder and, for many years, partner of the well known firm of Siemens & Halske. He was born at Hamburg on July 30, 1814, and went to Berlin, where he set up an engineer's shop in 1844. Soon after he made the acquaintance of Werner Siemens, and it was in Halske's workshop that Werner Siemens, assisted by the mechanical skill of the former, was able to work out his first inventions in telegraphy, so as to bring them before the public. In 1847 the two men entered into partnership and laid the foundation of the telegraph construction works which at the present day give employment to thousands of workmen, both at Berlin and Charlottenburg, and at several branch establishments. Halske left the firm in 1867, and since then has been an active member of the municipality of Berlin.

A Balloon with Compartments.

Mr. Andre Mahoudeau describes, in *Les Inventions Nouvelles*, a new kind of balloon devised by him, and divided into several compartments, according to the principle applied in navigation. One of the advantages of this system is that a rent in the balloon does not imperil the life of the aeronauts.

Each compartment is provided with a pipe that descends through a central funnel. In this way, it is possible to inflate the compartments independently of one another, and with gases of different natures.

This arrangement is necessarily accompanied with a certain increase in weight, but this is but 77 pounds for a balloon of 6,700 cubic feet capacity.

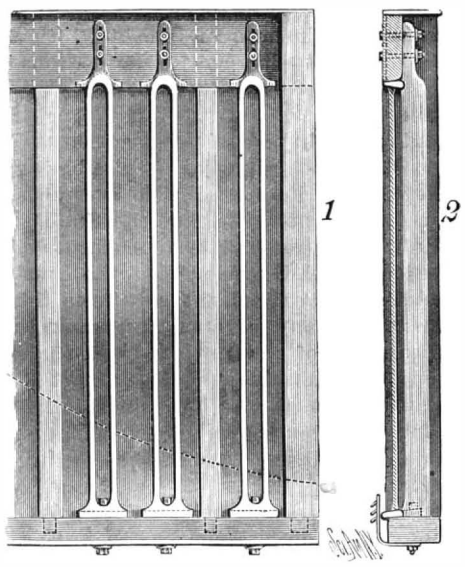
AN IMPROVED WATER TOWER AND EXTENSION LADDER.

In the machine represented in the accompanying illustration, telescoping pipes form the water tower, with split glands and a screw on the end for locking each pipe in place on to the next following pipe. The invention has been patented by Mr. Edwin Crippen, of No. 18 North Broad Street, New Orleans, La. The exterior pipe is pivoted at one end on a turntable, and moving pistons are pivotally connected with it above its fulcrum, with fixed inclined cylinders, in which the pistons are made to travel by means of compressed air, there being an intermediate mechanism for pivotally connecting the pistons with the exterior pipe. The machine has reservoirs charged with compressed air, and of a capacity double the amount necessary to extend the tower to its extreme height, while a small air pump is mounted on the apparatus to charge the reservoirs and keep the pressure substantially uniform at all times. The exterior pipe has solid trunnions, and a pipe between them forces air into the telescoping pipes, links being pivotally connected with the exterior pipe, and piston rods connected with the links to operate pistons in fixed inclined cylinders, with means for locking the exterior pipe to the cylinders.

The apparatus has an extension ladder comprising a series of sections, one of which is secured to the central telescoping pipe, and the sections have hooks and staples whereby one section may be readily made secure to the next following section, there being guiding brackets for the ladder sections and screws for locking them in place. The apparatus when raised in position is to be supplied with water under pressure, as usual, from fire engines or other sources, and has a flexible nozzle or play pipe, the valve communicating with which can be opened from the ground by pulling a rope. The water is directed on to the fire by an operator standing on the platform at the upper end of the largest or lower section of telescopic pipe. The apparatus may also be used as an extension ladder without a fire engine, and the ladder can be turned in any direction by the operator taking hold of the legs to turn the turntable. The tower and the extension ladder may then be inclined so that the upper part of the ladder or tower may lean against the building, and form a means of communication therefrom to the ground.

AN IMPROVED BRACE FOR PIANO STRING FRAMES.

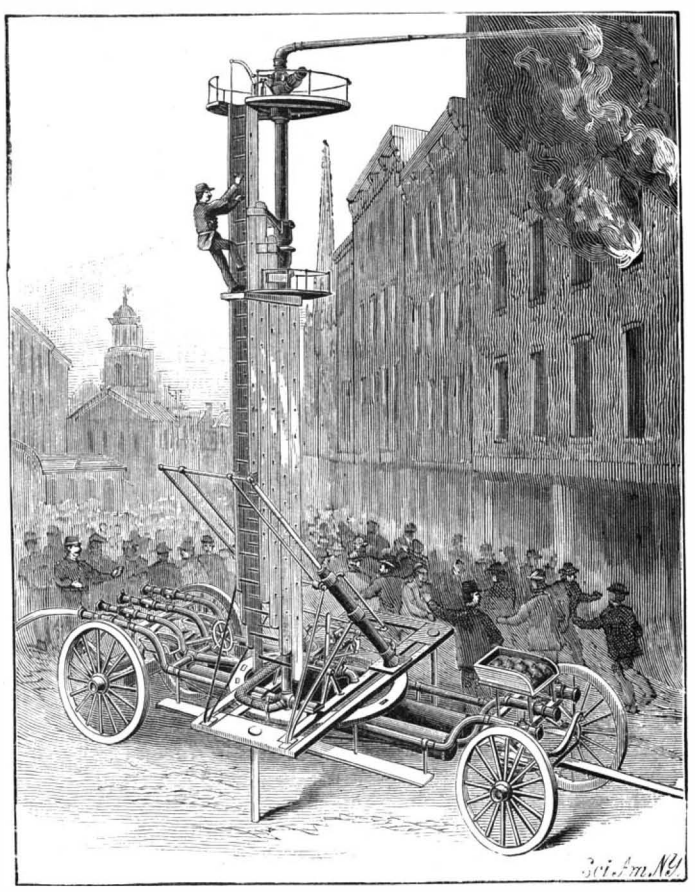
An invention designed to provide for the support of piano strings in such a manner that they will retain their pitch, but will be held with a certain amount of elasticity, adapted to insure a rich, full, mellow tone, is illustrated herewith, and has been patented by Mr. John Jaworsky, of No. 156 Bergen Street, Brooklyn, N. Y. Fig. 1 is a rear view, and Fig. 2 a cross section of a frame in which this improvement is embodied.



JAWORSKY'S BRACE FOR PIANO STRING FRAMES.

That the wrest-plank may be held against undue yielding by strain from the tension of the strings, iron braces are employed, with upper forwardly extending lips upon which the wrest-plank fits, and with lower forwardly extending lips which rest upon and extend in advance of the sill. The braces are centrally divided to form vertical lengths, and have upwardly extending slotted tongues to provide for the passage of the retaining bolts. The sounding board is secured to the end braces, and extends in advance of the iron braces and intermediate wooden braces arranged in the spaces between the iron braces. The tuning pegs are secured to the wrest-plank in the ordinary way. This frame is designed to render the use of the rigid cast iron plate unnecessary, leaving the sounding board free to respond to the vibrations of the strings, which, being supported at their upper ends by wood, assures a certain amount of pliability and elasticity, while the wooden frame is sufficiently braced for the retention of the pitch to which the piano has been tuned.

ADULTERATION OF AN ADULTERANT.—The United States consul at Stettin in a recent report calls attention to the adulteration of the chiccory exported from there. From inquiries which he made he learned that the larger part of the chiccory is made from beet roots, dried and burnt or roasted, and prepared in the same manner as pure chiccory. The mixture usually sold as chiccory is composed of one-third of the pure article and two-thirds of roasted beet roots. It is invoiced at about 1½d. per pound, a price at which it is quite impossible to get genuine chiccory.



CRIPPEN'S WATER TOWER AND EXTENSION LADDER.

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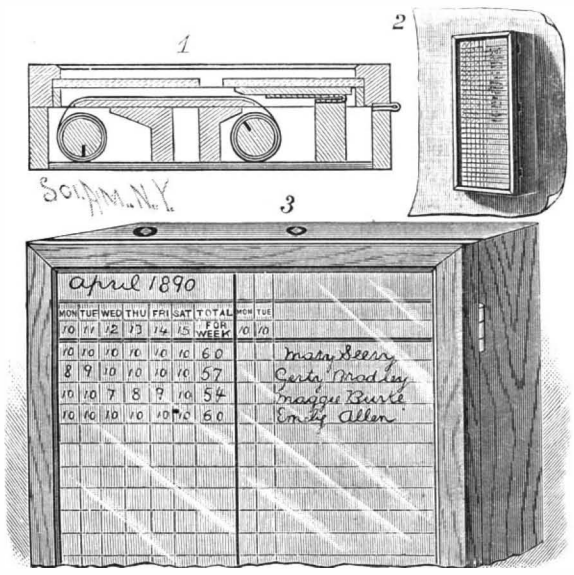
AN IMPROVED TIME REGISTER.

The illustration represents a register designed as a convenience in factories, mills, etc., to facilitate keeping the correct daily time account of the work of each individual. It has been patented by Mr. Leverett W.



TIFFANY'S TIME REGISTER.

Tiffany, of Winsted, Conn. Figs. 2 and 3 are views in perspective, and Fig. 1 is a sectional plan view. The time sheet is placed on rollers within the casing, one roller being, as shown in Fig. 1, on each side of a table over which the sheet is drawn so that it may be readily marked upon with a pencil or pen through an opening or slot in the cover. The slot is preferably formed by spaced glass plates fitted in the cover. Beneath the plate at the right is held a narrow slate on which the names of the employes are written, as shown in Fig. 3. The rollers are turned to shift the time sheet by a key inserted in holes at one end of the casing, and to prevent their turning back they are journaled in a spring plate which lifts them against the top of the main frame and acts as a brake. Attached to the cover is a plate adapted to enter a slot in the main frame when the cover is closed, and wholly prevent a key from being applied to turn the time sheet back except by one having a key to the cover. The time sheet is preferably ruled for each day in the week, and adapted, as shown, to bring the columns in line with the opening in the slot.

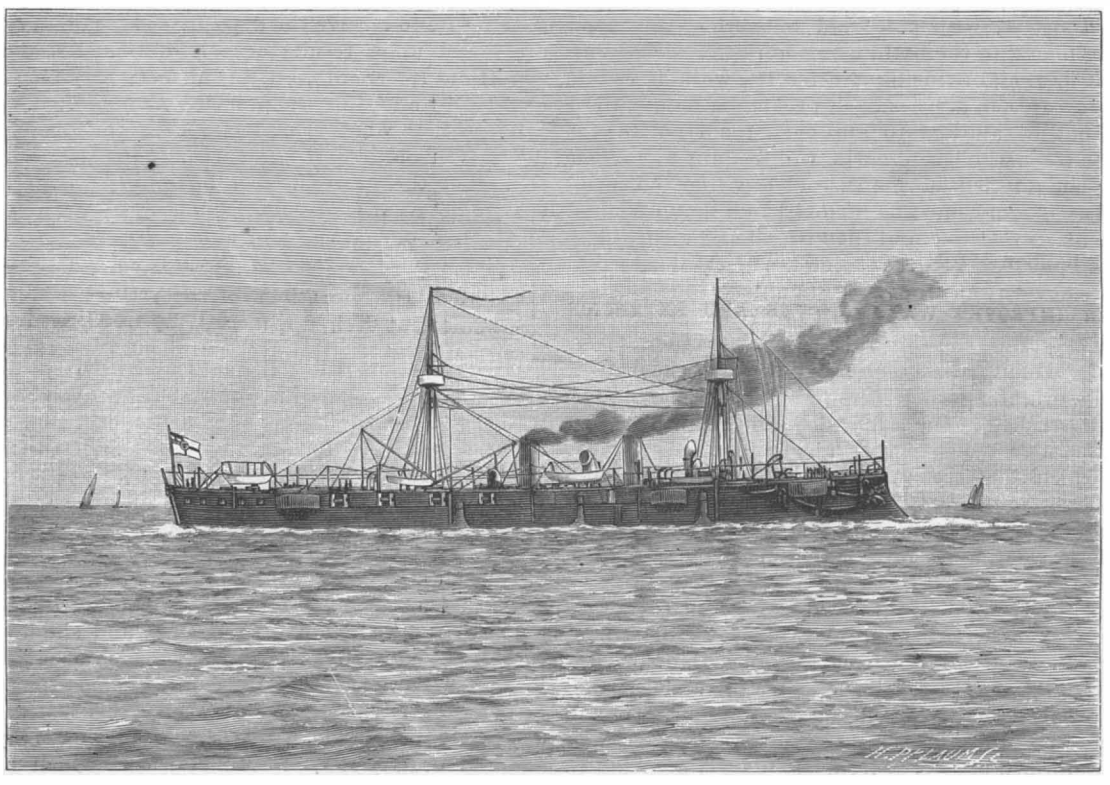
NEW GERMAN ARMOR-CLAD CRUISERS.

As regards naval affairs, the Germans seem to be collecting their thoughts. They are devoting much study to foreign fleets, but are constructing nothing very new. It would seem that no programme has as yet been definitely resolved upon. The use that is to be made of the extraordinary appropriation that has just been voted is kept a secret. We propose to make known at present two of the modern cruisers of Germany—the Irene and the Princess Wilhelm, which belong to a new type called on the other side of the Rhine the protected cruiser.

The Irene, which we shall alone describe, displaces 4,400 tons. She is 308 feet in length and 45 feet in width. Her engine is of 2,000 horse power. She made 18 knots an hour on her trial trip.

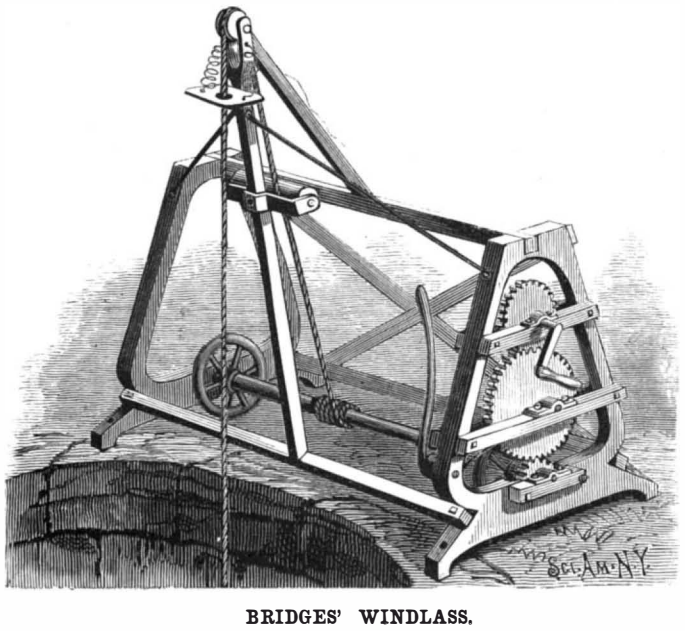
This vessel is protected solely along her coal bunkers. It is provided with an armor plate deck strongly curved, so as to descend to a considerable depth below the load water line. The engines, two in number, are placed in distant compartments totally independent of each other. Each of them actuates a screw under cover of the lines of the stern. The supply of coal and ammunition is very large. Cruisers of this type have to navigate by steam only, and their masts, which are military ones solely, are deprived of yards.

The armament consists of a barbette battery of 14 six inch guns, one on each side, away forward, firing through a port hole. Four sponsons, permitting of firing fore and aft, contain, each of them, one gun, and comprise between them the eight other pieces, which are placed simply upon the deck and have but quite a limited field of fire. Upon the shields and in the tops are installed eight revolving guns. Three torpedo tubes are placed at the extremity of the ship. The Irene carries a crew of 320 men.



NEW GERMAN WAR SHIP, THE IRENE.

Let us add that the present German fleet comprises five ironclads remodeled prior to 1870. In case of war, these vessels would form an open sea squadron. The defense of the coasts would be assumed by four cruiser corvettes, without masts, making scarcely 12 knots per hour. The German navy includes in addition the ironclad Aldenburg, a remarkable vessel, 21 gun boats, and an old monitor, the Arminius. Its cruisers are well armed, and its torpedo boats are numerous. There are also special gun boats, which carry 8 guns, and are designed for Africa.—*La Nature.*



BRIDGES' WINDLASS.

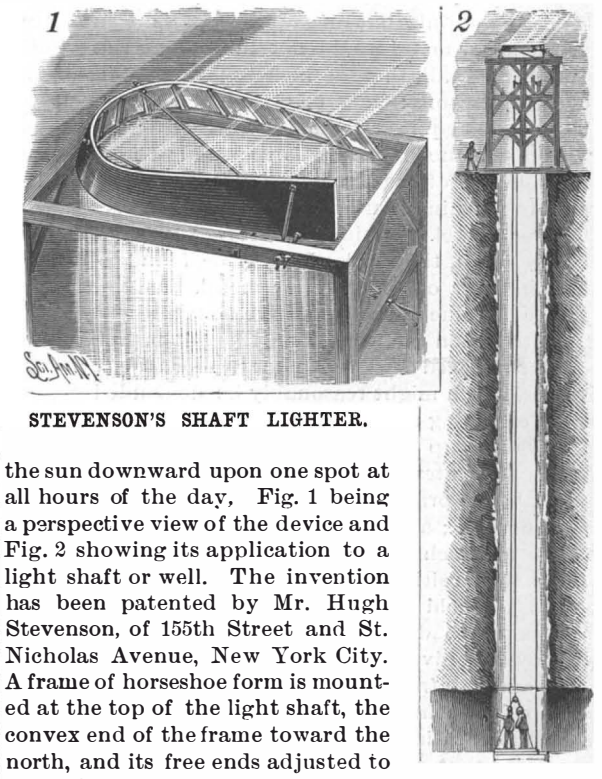
AN IMPROVED WINDLASS.

The illustration herewith represents a windlass specially designed for hoisting well buckets and similar uses, and to be rapidly operated with the least possible expenditure of power. The several parts of the frame are bolted together, and its foot pieces have perforations for bolts for securing the windlass in position. The windlass shaft is mounted in bearings in the ends of the frame, and at one end has a small pinion meshing with a large gear wheel, a spur wheel meshing with this gear wheel, the spur wheel having an operating crank. In the front brace or crossbar of the frame is mounted an upright, the upper end of which has a grooved pulley, over which passes the hoisting rope, there being, lower down on the upright, laterally extending arms or brackets having bearings for a horizontal guide roller. A small horizontal platform is held suspended by means of coiled springs from the upper end of the upright, and has a perforation for the passage of the hoisting rope. The windlass shaft has a balance wheel at each end, and at one end is pivoted a bell crank lever with a shoe on its lower arm adapted to bear against the periphery of one of the balance wheels, thus constituting a brake which may be easily manipulated.

For further particulars with reference to this invention address Thomas H. Bridges, the patentee, Valley Mills, Texas.

AN IMPROVED SHAFT LIGHTER.

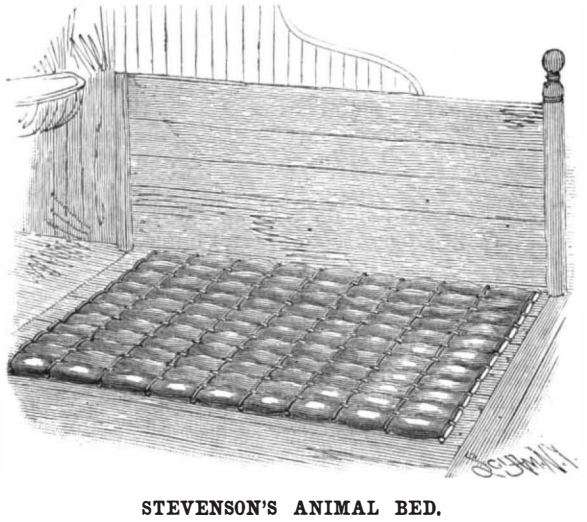
The construction shown in the accompanying illustration is designed to provide for directing the rays of the sun downward upon one spot at all hours of the day, Fig. 1 being a perspective view of the device and Fig. 2 showing its application to a light shaft or well. The invention has been patented by Mr. Hugh Stevenson, of 155th Street and St. Nicholas Avenue, New York City. A frame of horseshoe form is mounted at the top of the light shaft, the convex end of the frame toward the north, and its free ends adjusted to an angle of about forty-five degrees. On its inner side the frame has a series of reflecting surfaces. The convex end of the frame is supported by a bracket, and its extending ends rest loosely upon brackets at the sides. Each end of the frame is connected by two rods, one over the other, with the side walls of the light shaft, the rods carrying nuts, whereby the ends of the frame may be adjusted at a proper angle to reflect the light down the shaft. In the summer the convex end of the frame should be practically vertical, but in winter a slight angle of inclination is desired, and to effect this two rods are made to extend from this end of the frame to a fixed support, the rods being so proportioned as to length that the winter temperature will contract them sufficiently to give the required incline. With this construction, as the sun travels round, it bears successively, from its rising till its setting, upon the different reflecting surfaces of the horseshoe frame, from one end to the other.



STEVENSON'S SHAFT LIGHTER.

AN IMPROVED ANIMAL BED.

A bed designed more particularly for horses, and so constructed as to be durable, dry, and comfortable, while adapted for use with or without the ordinary straw bedding, is shown in the accompanying illustration, and has been patented by Mr. Hugh Stevenson, of 155th Street and St. Nicholas Avenue, New York City. The bed is formed of elastic tubes, preferably made of rubber, and held in place by transverse strips and binding strips to constitute a number of series of practically air-tight chambers. The compartments may be formed after the tubes have been vulcanized, by drawing the binding strips down tight. There are sufficient spaces between the aligned cushions thus provided to insure thorough ventilation and cleanliness.



STEVENSON'S ANIMAL BED.

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Practical Hints on Cobalt Plating.

BY ALEXANDER WATT.

Since cobalt as a coating for other metals, as brass, copper, and steel, for instance, presents some advantages which would render cobalting a useful substitute for nickel plating, I have lately made a series of experimental trials with a view to point out as far as possible the most favorable conditions under which successful and uniform results may be obtained in the deposition of this metal for practical purposes. Cobalt, being a whiter metal than nickel, would be a useful coating for ornamental brasswork, as also for small fancy articles in which a cheap white metallic film is desirable. Being softer than nickel, articles coated with cobalt may readily be brightened by burnishing, a process that could not advantageously be applied to nickel-plated surfaces. Like nickel, cobalt is a non-oxidizable metal, and therefore retains its color in ordinary atmospheres. Although cobalt is a dearer metal than nickel, I am disposed to think that its employment as a substitute for the latter metal would not in the long run greatly exceed, if at all, that of nickel-plating, and for the following reasons: Only one-third of the quantity of "salts" are required to make up a bath; about one-third of the anode surface is required; the deposited metal, being softer than nickel, naturally requires less labor in finishing; and, finally, less current is required than for nickel. Taking, therefore, these points into consideration, they will probably be found to balance those in favor of the cheaper metal. As to the difference in value of the respective metals when actually deposited upon the work done, this might probably be counterbalanced by extra charges for the cobalted articles, which might reasonably be demanded so long as the cobalting remained a novelty.

In making up a bath, the salts employed were the double sulphates of cobalt and ammonia, this compound being practically the most suitable for commercial purposes; and in order to ascertain the proper density at which the bath should be prepared, solutions of various densities were tried, and the one which appeared to yield the best results was selected. The next point to determine was the density of current which would give a perfectly adherent deposit of good color, and free from "burning" at the corners of a flat plate or projecting surfaces of an article. After making many modifications in the strength of the solution, it was found that a bath of the specific gravity of 1015 (water being 1,000) at 60° F. gave the best results, and this was obtained by dissolving 4½ oz. of the double sulphates of cobalt and ammonia in one gallon of water. This solution worked most favorably with a current of about 0·800 ampere, the E.M.F. being about two volts. The electrodes used in the first trials were a well-cleaned brass plate 3 in. by 2 in. for the cathode, while the anode consisted of a plate of rolled cobalt, supplied by Messrs. Henry Wiggin & Co., of Birmingham, from whom also the cobalt salts were obtained. The next point to determine was the amount of anode surface which was necessary to admit of a prompt deposit, and yet not too quick for an adherent film. With the current named, and about equal electrode surface, it was found necessary, after a few minutes' immersion of the brass cathode, to remove a considerable portion of the anode from the bath, in consequence of the plate becoming blackened or "burnt," as it is termed, at the corners; when the surface of the anode was reduced to about one-third that of the brass plate, deposition took place with perfect uniformity, and there was no longer the least tendency to the discoloration referred to. It thus became evident that an important consideration in the electro-deposition of cobalt is the amount of anode surface which is most suitable in a cobalt bath of a given density. In nickel-plating, as is well known, this is not a matter of so much importance, and it is commonly the practice to employ a very large surface of anodes in the baths, almost regardless of the actual surface presented by the articles suspended in the solution. My object in directing special attention to this difference between the operations of cobalting and nickel plating is that I believe that one of the reasons why the electro-deposition of cobalt has not been successful in some hands is that too little attention has been paid to the detail I have pointed out.

To prepare a solution bath for cobalt plating, 4½ oz. of the crystals of double sulphate of nickel and ammonium for each gallon of the bath should be dissolved in hot water, and the solution then made up to the required quantity by the necessary addition of cold water. The solution should then have a specific gravity of about 1015 at the temperature of 60° F. For the successful deposition of cobalt upon articles formed of brass, copper, steel, or iron, the anodes may be of rolled cobalt, in narrow strips, say about 2 in. wide and 12 in. to 18 in. long, according to the size of the depositing tank. The anodes should be placed about 6 in. apart along the sides of the tank, and in the case of large tanks, say vessels holding 200 or 300 gallons or more, a corresponding series of anodes should be suspended from a conducting rod placed lengthwise, and resting on the ends of the tank, as in nickel plating, etc. All work to be coated with cobalt should be polished and prepared for the solution precisely in the same way as for nickel plating, and before they are immersed in the bath the current must be so regulated that the work may become coated with a film of metal, or "struck," as it is termed, within a few seconds after being placed in the bath. There need be no fear of the work stripping—provided it has been properly potashed and scoured—if the articles become coated immediately after immersion, but in this case the current must be at once reduced, otherwise the work is sure to "burn," or become discolored, at certain parts in a few minutes after. It is far preferable, indeed necessary, after the first film has been obtained, to immediately diminish the current, this being again augmented when other articles are put into the bath. By watching the rate at which each article becomes coated, and regulating the current accordingly, the probability of burning the work will be readily overcome. My reason for directing special attention to this is that cobalt deposits so much more readily than nickel that any person unacquainted with the deposition of cobalt and treating it as he would nickel might naturally fall into error, readily avoided, which would cause failure and disappointment. It should always be the rule, therefore, in cobalt plating to diminish the current so soon as the article is fairly coated all over, but more especially is this the case when the work becomes coated instantly after immersion. Since copper does not appear to receive a deposit of cobalt quite so readily as brass with the same amount of current, it will be found advisable, when copper articles are to be cobalted, to start with a somewhat stronger current than would be required for the yellow alloy; but when the piece of work has fairly struck all over with the stronger current, this must afterward be reduced somewhat during the remainder of the time the article is in the bath. In cases where a dead cobalt surface is required, the articles, having been dipped in the usual way, may be scoured with powdered pumice, or, still better, with powdered bath brick, and after rinsing placed in the bath, using a rather strong current at first, and reducing it after the work is coated all over. If such articles have projecting points, these must not be allowed to approach too close to the anodes, otherwise such parts will be apt to become dark; should such be the case at any time, however, the piece of work must be removed and again scoured at the discolored spot and then rinsed and returned to the bath, a weaker current being used. All dead work, after removal from the bath, should be plunged into clean boiling water and allowed to dry spontaneously, care being taken not to handle the work at such parts as will be required to present a clean white surface. When a brighter surface is required, the work may be scratch-brushed at the lathe with brushes made from fine steel wire, moistened with beer in the usual way, after which the pieces may be dipped in a solution of cyanide of potassium, and finally rinsed in boiling water and then put into clean box sawdust. Buttons and other small fancy brass articles may be treated in this way.

In depositing cobalt upon steel or iron surfaces a much weaker current is required than for either brass or copper. The current from a single Daniell cell is amply sufficient for coating small steel articles, and, since cobalt adheres very firmly to this metal, it will be found useful for imparting a white coating to many articles formed of steel or iron. It is also important to note that steel articles coated with cobalt may be brightened by ordinary burnishing, for, as before observed, cobalt is softer than nickel and yields very readily to the pressure of the burnisher. When depositing cobalt upon cast iron, a rather strong current must be used to secure an immediate coating after the work has been placed in the bath, after which, as before, the strength must be diminished and sustained at a uniform density until a sufficiently stout coating is obtained. Here, again, it is necessary to point out that projecting surfaces must be kept as far away from the anode as possible, so that those portions may not become discolored or "burnt" and necessitate rescouring.

There is another feature in cobalt depositing which presents an advantage over nickeling which it is well to mention, namely, that when it is found necessary from any cause to rescour a piece of work and return it to the bath until finished, the operator need not fear, I believe, that the work will be liable to strip after the second coat has been given, for I have generally found that brass and even steel surfaces may be frequently rescoured and cobalted again and again without the metal stripping in the least degree. In the case of nickel we all know that the deposition of film upon film of this metal is almost invariably succeeded by the second coating separating from its predecessor. It may be further remarked that the rescouring of the work, to produce an improved surface upon a defective film, can scarcely be applied to a nickel-plated article, owing to the extreme hardness of the metal. With respect to cobalt, however, the case is different, for with good brisk brushing with pumice, silver sand, or bathbrick reduced to a powder, I have found no difficulty in producing the surface necessary for a satisfactory deposit of the metal when from various causes it was found necessary to repeatedly rescour the plates used in the experimental trials referred to. In no instance, however, did the subsequent layers of cobalt strip or peel off the metal already deposited.

Some attempts were made to deposit cobalt upon zinc from the double sulphate solution, but in each instance it was found that the film was non-adherent, except in portions of surface where partial adhesion of the metals occurred. Although there are some other solutions of cobalt than the above which would be more suitable for cobalting zinc, it is somewhat doubtful whether a really good deposit of cobalt on this metal could be obtained with any degree of certainty.

In working the solution prepared from the double sulphates of cobalt and ammonium, it appears to be necessary to maintain the liquid at as uniform a density as possible, and for several reasons. For instance, if the bath be allowed to acquire a higher density than about 1,015, by the spontaneous evaporation of a portion of its water, the color of the deposit will probably become affected, and a darker tone imparted to the articles instead of a tolerably good white characteristic of electrolytic cobalt when deposited under more favorable conditions. To obviate such a defect in the metallic strength of the bath, the hydrometer should be floated in the liquid at least once a week, especially in warm weather; and whenever the solution indicates a higher density than it originally had, an addition of water must be made until the specific gravity has been reduced to the proper figure. These additions of water, however, should be made in the evening, or when the bath is not being used, and the solution must be well stirred, and then allowed to rest for at least 12 hours. It is also necessary to avoid adding an excess of water, since a solution much weaker than that indicated will be apt to cause the deposit to be patchy, and certain parts of the article may for a time refuse to receive the deposit. These observations are based upon results actually obtained under the conditions referred to, but the defects may readily be avoided by adopting the precautions suggested.

Respecting what is understood as the *color* of the deposit, this is greatly influenced by the strength and tension of the current. For instance, it is perfectly easy to obtain film of cobalt upon brass surfaces with an E. M. F. of one volt and a large surface of anode, but this deposit will not be so white as when the current has an E. M. F. of two volts, with small anode surface—that is, about two-thirds less than that of the cathode, or article to be coated.

With respect to the purposes to which cobalting is most applicable, these may be taken as being, on the whole, similar to those for which nickel plating is adopted, but, like the latter metal, it should never be applied to culinary or drinking vessels, since it is, like nickel, readily acted upon and stained by vegetable acids, vinegar, for example, beer, and also by vegetable infusions, such as tea, the water in which cabbages have been boiled, and other liquors of a similar nature. Cobalt also resembles nickel in becoming dull when long exposed to damp atmospheres, and should not, therefore, be employed for articles which are required for out-of-door ornamentation, unless the surfaces can be persistently rubbed over with a dry leather every day. On the other hand, cobalt plating may be adopted for any class of art metal work which is destined to remain in ordinary dry apartments, as fenders, fireirons, etc., or for ornamental work to be worn on the person. Mullers, sausage warmers, dental instruments, and cast brasswork, such as lavatory taps and so forth, may be advantageously coated with cobalt, the articles being prepared and finished as before observed precisely in the same way as in nickel plating.—*Electrical Engineer*, *London*.

New Zealand Sulphuric Acid Works.

The long-closed sulphur works at Tauranga, 100 miles south of Auckland, are about to be opened, and utilized in the manufacture of sulphuric acid, by Messrs. Sharland & Co., of Auckland. On a small islet, called White Islet, some miles off the coast, there is an inexhaustible supply of crude sulphur in a high degree of purity, but, owing to the lessee and part owner of the island refusing to allow it to be worked, this source is not available; but at Matata, some 50 miles south of Tauranga, there is another enormous deposit of sulphur. Other localities, too, not far removed are rich in this element, and the proprietors of the works will have no difficulty in obtaining supplies.

PRESERVE FOR BINDING.

The publishers of the SCIENTIFIC AMERICAN would advise all subscribers to preserve their numbers for binding. One year's issue (52 numbers) contains over 800 pages of illustrations and reading matter. The practical receipts and information contained in the Notes and Queries column alone make the numbers worth preserving. Persons who have subscribed since the commencement of this year can have the back numbers sent them on signifying such wish. Their subscription will then expire with the year.

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THE WESTINGHOUSE INTERLOCKING SWITCH AND SIGNAL SYSTEM.

(*Continued from first page.*)

only drawn back and pushed forward a trifle corresponding to the versed sine of the same arc, 1–2. From 2 to 3 the first relations are re-established; the lock bolt is thrust forward into the hole in the lock bar and the switch is hardly moved at all. A detector bar is worked simultaneously with the lock bolt by means of the rod, F, of the perspective drawing.

Referring again to the cut of the switch board,* a series of studs or latches are seen projecting through holes below the switch handles. These, if moved upward, catch the lower projecting ends of the switch handles. They are raised and lowered by the agency of the signal handles. As each of these is moved it throws a notched bar that runs parallel to the face of the case to the right or left. The bar, according to the arrangement of the notches, throws upward or permits to drop any one or more of the latches. When raised a latch locks the lever above it, when depressed it frees it. Thus a mechanical interlocking of switch and signal handles is provided that by different disposition of notches may make the movements of one or more switch handles depend upon the movements of any given signal handle.

On the rear end of each signal spindle on the switch board is a quadrant which swings to right or left as the spindle is rotated. This has teeth in which a latch engages. This latch is operated by an electro-magnet in the rear included in the independent signal circuit just described. When the signal is at "safety," this circuit is open, and the magnet not attracting its armature, the latch, by gravity, locks the quadrant as to allow only a small degree of movement to the signal handle with its spindle. This movement is enough to close the main circuit and thus release the semaphore, which rises to "danger," but not enough to lower the interlocking latch or latches projecting from the front of the case, until the semaphore has risen the full distance to "danger." As it reaches this position

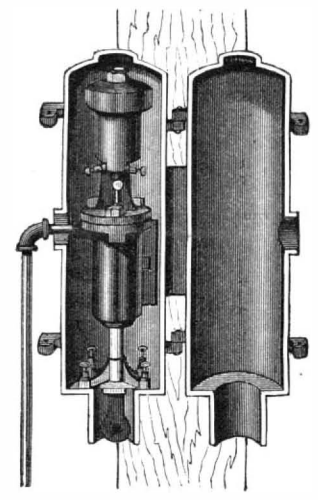


Fig. 3.—SIGNAL—MOVING MECHANISM.

the auxiliary or locking circuit is closed, the magnet attracts its armature, drawing the quadrant latch out of engagement with the quadrant, and the handle can now be swung clear over, unlocking the switch handles dependent upon it.

On the rear end of the switch spindle in the switch board are similar quadrants, whose locking latches are actuated by an electro-magnet connected with the circuit breaker on the switch-throwing mechanism. At the end of the locking bolt, H, of this mechanism, Fig. 1, is a circuit opener. When the bolt is in place and the switch locked as shown, the circuit is open. This opener is in circuit with the electro-magnet back of and actuating the quadrant-locking latch appertaining to its own spindle on the switch board. This is so constructed that a limited movement only is allowed when the circuit is open. This movement is enough to turn the three-way cock. The switch begins to move. As the locking bolt, H, Fig. 1, comes back, the circuit closes. The magnet attracting its armature unlocks the quadrant and instantly relocks it. This is done so quickly that the handle cannot be moved during the change. The switch continues its movement. As it is thrown and locked, the circuit opens, the quadrant is free, and the handle can be swung clear over. Its first movement was only sufficient to open the cocks, but not enough to close the signal-actuating circuit by the strips of metal on its spindle. This is done by the second motion. Hence as the signal cannot be moved until this circuit is closed, and as a semaphore cannot be set at safety without this closing of circuit, the protecting semaphore cannot be set at "safety" until all the switches in its system have been completely thrown and locked by the regular locking bolt.

Above the case containing the switch and signal handle mechanism and connections, and facing the operator, is a miniature model of the tracks and switches controlled by the switch board. The model has movable switches, which repeat the movements of the actual switches, so that at a glance the operator can see what position every switch in the system occupies. An annunciator drop is also placed in view of the operator. This is worked electrically by any train approaching the system, which train causes a bell to ring and also drops the shutter when it is within a mile of the track yard.

* We are indebted to Messrs. Charles Scribner's Sons for the use of this cut, which was published in "The American Railway."

New Hoisting Plant of the Calumet and Hecla Mining Company.

The new hoisting plant recently built by the Calumet and Hecla Mining Company, at Calumet, Mich., is one of the most elaborate ever erected. It consists, says the *Engineering and Mining Journal*, of three triple expansion, vertical inverted beam engines, designed to hoist 10 tons at a speed of 2,000 feet per minute. The cylinders are 18 inches, 27¾ inches, and 48 inches in diameter, all by 7 foot 6 inch stroke. Each is provided with 4 gridiron valves worked by independent cams, so made as to equalize the cut-off. The high pressure cylinder only is provided with an adjustable cut-off, ranging from 0 to nine-tenths stroke. This is automatic, and is controlled by a hydraulic governor actuated by a high speed ball governor. Between the high pressure and intermediate cylinders and the intermediate and low pressure cylinders are reheating receivers. The shaft is hollow, 29 feet long, 22½ inches in diameter, with a 7 inch hole throughout its length. Its bearings are 22 inches by 40 inches. The shafts, cranks, pins, piston rods, cross heads, and links are made of the finest quality of Krupp crucible steel. The outboard pedestal of the shaft is provided with a ball and socket shaft. The fly wheel is 30 feet in diameter.

The hoisting system is the constant motion non-reversing friction system, the drum rotating with the engine shaft when hoisting and on the shaft when lowering. The hoisting drum is conical, 27 feet in diameter at one end and 14 feet 7 inches at the other, and turned with a spiral groove to accommodate 5,500 feet of 1⅜ inch wire rope. The engine, by means of an automatic device, varies its speed from 30 to 45 revolutions per minute, thus hoisting at a uniform rate. The power is thus varied as more or less rope is to be hoisted. The engine house, which contains also the pumps and accumulators, is 112 feet long by 68 feet wide, and is commanded by a 30 ton traveling crane.

The boiler house is 76 feet by 68 feet. It contains five boilers of the Belpaire type, 90 inches in diameter. They are the largest Belpaire boilers ever built, and weigh 86,000 pounds each. The fireboxes are each 4 feet 7 inches wide inside by 9 feet long, but the last 18 inches are covered by firebrick. A brick arch extends from this wall toward the fire door. There are 201 tubes 3 inches in diameter and 16 feet long in each boiler. The flues from the firebox to the combustion chamber are 3 feet 3 inches long, and the combustion chamber is 4 feet 3 inches long. The total length of the boilers is 34 feet 5 inches, width over all 10 feet 5 inches, and height 9 feet 6 inches. The total heating surface of each boiler is 2,985 feet, and grate surface 68¾ feet. Ratio, 42·1 to 1. The circular shell is ¾ inch thick, the outer firebox $\frac{9}{16}$ inch, and the inner firebox ⅜ inch thick. Tube sheet ½ inch thick. All sheets are of Otis steel, of 37,000 pounds elastic limit, and 20 per cent elongation in 15 inches. The working pressure is intended to be 185 pounds per square inch.

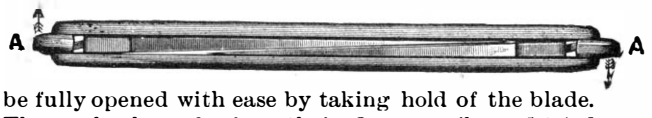
These boilers have shown themselves capable of giving out 1 horse power for each 4 square feet of heating surface when driving a compound engine. The Calumet and Hecla Mining Company has in service and ordered 46 of these boilers, 19 of which carry 185 pounds steam pressure, and the remainder 135 pounds.

Unstable Sand.

A rather remarkable accident is described by Herr Schilling in a recent number of the *Centralblatt der Bauverwaltung*. During the construction of the Neustrelitz and Wammund Railway, a small stream, the Recknitz, some 16½ ft. wide by 5 ft. deep, had to be crossed near Laage, and it was determined to span this by an arch. To secure good foundations for the abutments, it was necessary to pass through a stratum of peat 16 ft. thick, below which was found a bed of fine sand, on which the foundation courses were laid. The two excavations were made by driving steel piles around the area to be excavated and then removing soil in the usual way, and the bed of the river was not interfered with in the least. The spaces inclosed measured 28 ft. by 13 ft. each, and the piles were driven 5 ft. into the sand. There was no difficulty in removing the first 10 ft., but after that pumping had to be resorted to, a double suction and force pump being started at each side of the river. In this way another 3 ft. was removed, but to excavate the remaining 3 ft. it was necessary to concentrate all the available pumping plant in one pit, so that the other gradually filled with water up to the river level. Shortly after the masons had started work in the dry pit, the bottom suddenly burst up and the trench became half full of water, which curiously enough did not come from the river, but from the other trench, as was proved by the level of the water in this pit sinking as it rose in the other. The two pits were 50 ft. apart.

THE WILZIN AUTOMATIC KNIFE.

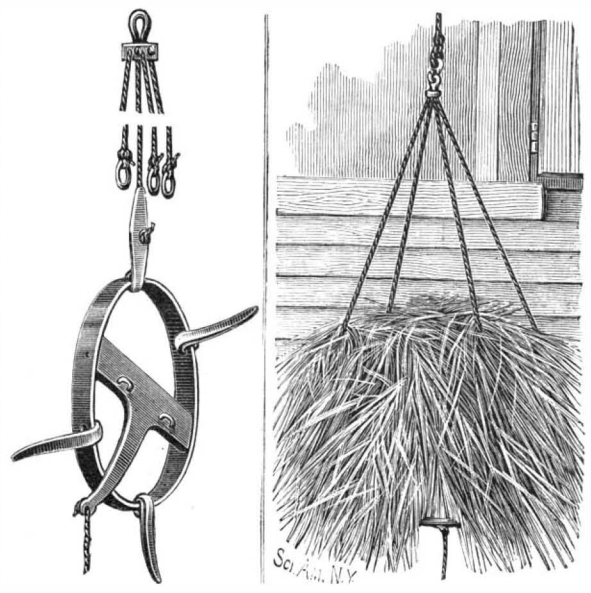
The knife represented in the engraving embodies a novel feature designed to win for it much favor. In each end of the handle, connected with the spring by which the blade is held closed, is a little tip or catch, by a slight pressure upon which, as indicated by the arrows at A, the blade flies partly open, and it can then



be fully opened with ease by taking hold of the blade. Those who have broken their finger nails and tried their temper in using knives which were hard to open will appreciate the means thus afforded of obviating the difficulty by simply pressing a catch. The knife is closed by pressing the blade into the handle in the ordinary manner. This invention has been patented in many countries, and the knives are made by the Automatic Knife Co., Middletown, Conn.

AN IMPROVED HAY SLING.

A device for lifting, carrying, and dumping loads of hay, straw, cornstalks, etc., is illustrated herewith, and has been patented by Mr. Joseph Unterbrink, of Ottawa, Ohio. It is a trip frame latch device to which a series of cords are attached to sustain the load, these cords being suspended from a plate held by any suitable overhead support or carrier to allow the loaded sling to be raised by pulley and rope or other mechanism, and moved over the place where the load is to be dumped, which is effected by simply pulling the latch string. The trip frame is a ring of metal to which are pivotally connected a series of trip arms, whose free ends are adapted to rest on or be retained by a latch



UNTERBRINK'S HAY SLING.

bar pivoted in the frame a little to one side of its center. This latch bar has an arm to which a pull cord is attached, and on one of its faces are eyes into which the free ends of two of the trip arms may be entered. Two other trip arms are adapted to rest at their free ends flat upon the opposite face of the latch. Three of the sling cords have rings at their ends, by which they are adapted to be detachably connected to three of the trip arms, but one of the sling cords is permanently attached to one of the trip arms, so that when the latch is slipped, the weight of the load will cause the cords to turn the trip arms instantly downward, allowing the rings to slip from three of these arms and cause the entire trip frame to be suspended from one sling cord, as shown in one of the views. The load is thus dumped quickly and in substantially the same condition as when loaded in the sling.

A Heavy Gun.

The first high power breech loading 8 inch rifle made entirely of American steel lately passed a successful test at the Naval Ordnance Proving Ground, at Annapolis. The gun is one of four intended for the cruiser Baltimore. Its forgings are from Bethlehem, and the machining and assembling were done at the Washington Navy Yard. With a sample of brown prismatic powder furnished by Messrs. Du Pont, of Wilmington, Del., a muzzle velocity of 2,129 feet per second was obtained with a 110 pound charge and 15·5 tons pressure. The projectile weighed 250 pounds and its velocity was the highest ever attained by an 8 inch shell in this country. Among other interesting features of the trial were the apparent ease and smoothness with which the enormous force of recoil—amounting to over 100 foot tons—was controlled in the short space of 27 inches, without jar or vibration, by the compact and light carriage on which the gun was mounted. This, says the *Army and Navy Register*, is one of the bureau's hydraulic center pivot carriages, and was constructed at the Washington Navy Yard.

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THE PROPOSED SUSPENSION BRIDGE ACROSS THE HUDSON RIVER AT NEW YORK.

We illustrate in our present issue the great railroad bridge proposed for erection between the States of New Jersey and New York, crossing the Hudson River near Hoboken and entering New York City. The necessary legislation and authorization for its erection seems in a fair way of being acquired. Should it become an accomplished fact, the city of New York will show to visitors not only the largest bridge in the world, but also, it may safely be said, the two handsomest. It has come to be pretty generally recognized that the cantilever type of bridge is as distinctively ugly as the suspension type is beautiful.

In our illustration on the opposite page we show the comparative sizes of four of the leading bridges now completed and of the proposed Hudson River bridge. Its main span exceeds by 1,150 feet that of the Forth bridge, at present the largest in the world. The same illustration is of interest as showing the appearance of three types of such structures—the arched truss, cantilever truss, and suspension bridge.

The necessity for so gigantic a bridge and the justification for its erection are found in the record of the ferry passengers over the Hudson River ferries. Upon the New Jersey shore a number of railroads have their termini, nearly one thousand trains arriving and departing every day, and it is estimated that about twenty million of their passengers alone cross annually. Besides these, an equal number of other persons are estimated to cross, making a total of over forty millions. Much delay is occasioned by the ice, by fog, and obstacles to navigation in general. The landings at the water front of the city are found inconvenient also. The design is to put the work upon a national basis, and to place its construction and the regulation of its traffic under the supervision of the Federal authorities in the person of the Secretary of War. Connecting two States, it is literally an interstate undertaking, and it will serve as one of the main arteries of travel between the entire West of the country and the metropolis. The privilege of free use for the transmission of postal matter and right of way for government telegraphs is to be ceded in return for the Federal recognition.

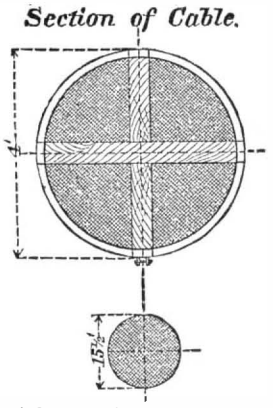
The main features of the colossal work may now be summarized. It is to carry six railroad tracks, but is to be built so that four additional ones can be introduced when required. The cost of a double track bridge is estimated at $9,000,000, of a six track bridge $15,000,000, while four additional tracks can be provided for at an additional cost of $1,000,000. Its western terminus in the State of New Jersey is upon the meadows between the Hackensack River and Bergen Hill. It is to pass through this hill by an open cut 100 feet wide. The rock from this cut will give the best possible material for concrete, and will be utilized as such. It will probably provide one-half the material required for the concrete of the towers and anchorages. On the eastern side of Bergen Hill, after the cut has been passed, is the first anchorage. This immense mass of masonry is designed on somewhat novel principles. The prevailing idea in its construction is accessibility. It is chambered so that the cables and the anchor irons within it can be inspected and their condition ascertained at any time.

From this the four great cables will start, each four feet in diameter and made up of steel wires laid parallel, as in the East River bridge. Each cable is to be divided by cross pieces into four quadrants. They are to be compacted into a cylindrical shape, and are to be covered with a sheet steel mantle or envelope of such size as to leave a two inch air space all around them. This will leave them accessible for repairs or examination, while providing ventilation, and is certainly an advance on the old system of wire serving.

At the edge of the river on either side the cables pass over steel suspension piers at a height of 500 feet above the water. These towers are of steel, each including sixteen columns 7 feet in diameter at the bottom and 5 feet at the top. The towers are planned to be erected without false work.

The cables are arranged in pairs, in two planes nearly vertical, one cable in each pair being fifty feet above the other. They are connected in the pairs by diagonal bracing, so as to constitute in themselves a truss that would possess sufficient stiffness for ordinary traffic. As a still further re-enforcement, the roadway is strongly trussed vertically as well as laterally, so that the heaviest locomotive will produce little or no local deflection. Four 16 inch wind cables are arranged to resist side stress from gales. After passing the eastern anchorage, itself well in the heart of the city, the roadway is carried into New York City, near Fourteenth Street, where a double-decked station is to be erected, giving thirty tracks for arriving and departing trains.

Section of Cable.



Cable for East River Bridge on same Scale.

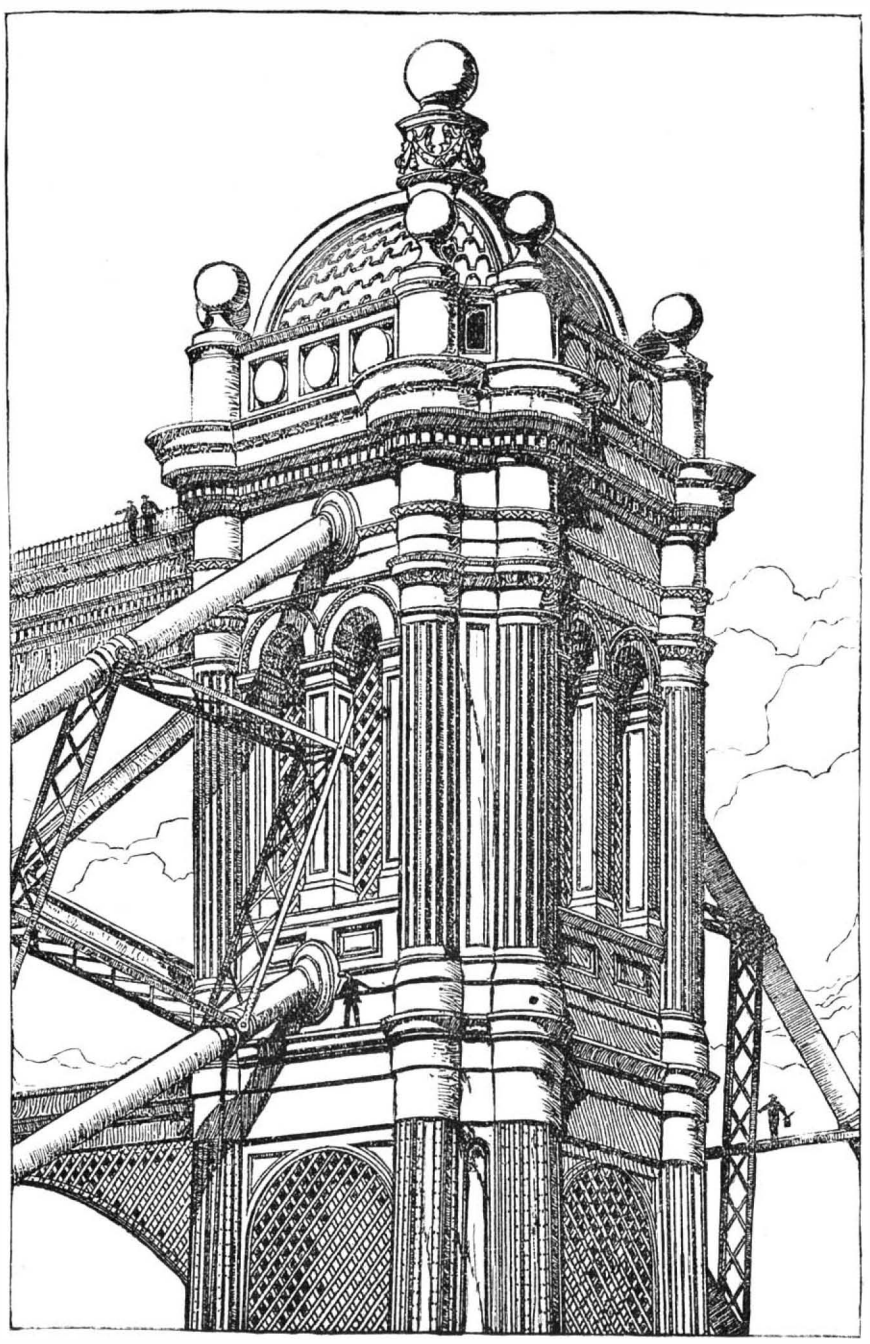
Experience teaches that such works are generally made too small for future needs. The size of this bridge is based upon definite considerations. It is believed that a ten track bridge will suffice for 120,000,000 passengers annually, or six times the present traffic. For its construction it is thought that about ten years will be required. A speed of thirty miles an hour is allowed for the trains which are to pass over it.

The following tabular statements are of interest. It will be seen that the cost of the bridge proper will represent less than half the total expenditure required for the approaches and stations.

COMPARATIVE DIMENSIONS OF THE EAST RIVER AND HUDSON RIVER BRIDGES.

	Brooklyn Bridge.	Hudson River Bridge.
Length, including anchorages....feet..	3,700	6,500
Height of anchorages..... " ..	85	210
Weight of each anchorage.....tons..	60,000	660,000
Length of each land span .....feet..	930	1,500
Length of middle span..... " ..	1,600	*2,850
Size of towers at high water mark..... " ..	140 by 59	340 by 180
Height of towers from high water..... " ..	272	500
Height of tower from the deepest foundation to top.....feet..	350	690
Width of bridge ..... " ..	85	86
Height above high water..... " ..	135	over 135
Length of one cable..... " ..	3,580	6,100
Number of cables.....	4	4
Finished diameter of cable .....inches..	15½	48
Number of railroad tracks	2	6 to 10
Grade on bridge.....per cent..	3¼	1⅝
Weight of iron and steel in the structure..tons..	6,750	60,000
Allowable speed of trains.....miles per hour..	10	30
Cost from anchorage to anchorage, exclusive of land damages.....	$5,600,000	$16,000,000

*In the clear.



DETAIL OF TOP OF TOWER OF HUDSON RIVER BRIDGE.

ESTIMATE OF COST.

The Hudson River Bridge, including the anchorages, 6,500 feet long.....	$15,000,000
The approaches of stone and iron and the connecting railroad switch yards, engine houses, the grand terminal station building and appurtenances	11,000,000
Right of way, interest during construction, and incidentals.....	14,000,000
Total cost.....	$40,000,000

The bill authorizing the construction of this bridge has passed the House of Representatives and is now awaiting action in the Senate.

A German Salmon Trade.

The duty imposed by Germany is equivalent to 10 cents per pound on canned salmon. The fish in a natural state may be imported duty free.

It is proposed to catch the salmon on the Columbia; the fish to be cut in two pieces and then packed in salt, thirty pounds of salt to one hundred pounds of salmon; the fish then must lie four days in the salt and then must be placed in cold storage for two weeks, then it must be shipped to Germany. The salmon must weigh twenty pounds each, as any smaller fish would become so thoroughly impregnated with the salt that it would be impossible to freshen them. A good sized salmon, it is claimed, can be made as fresh as it was the day it was taken from the river.

It is said the agent of a German house has already made contracts with a number of canners, agreeing to take all th salmon they can furnish on the above terms, cleaned fish, at six cents per pound, on the Columbia River.

With our facilities of refrigerator cars it would seem as if our Eastern markets ought to be supplied with fresh salmon at comparatively low prices.

The Pension Epidemic.

He who makes two pension claims grow where only one grew before is not entitled to the same blessing as the man who makes two blades of grass spring up where only one gladdened the eye before, but such an individual is at least sure of a hearing. I have wondered often, says a writer in the *Christian Union*, why some of the absurd claims for pensions were not outdone by demands for the government bounty on the part of men who did incidental service during the war in guarding Washington. These men were clerks in the various departments, and, when the Confederates menaced Washington, in 1864, were called upon to drill, to do guard duty, and to perform other soldierly duties, though not sworn into the service. Odds and ends of uniforms were issued these extemporized companies, and some ludicrous effects in attire were the result. I remember, the writer adds, that the trousers assigned me had one leg three inches shorter than the other, and I have often felt that the wear and tear of feeling I suffered because of my diversified appearance ought to warrant my application for what I would call a pensionette. It might well take the form of a gift of the price of a pair of trousers, the two legs whereof were of equal length, and the payment be made on the installment plan.

Great Guns for Russian Forts.

The largest gun yet manufactured at Krupp's works at Essen, which is intended for the naval fortifications at Cronstadt, is made of the finest quality of cast steel and weighs 270,000 pounds (about 135 tons), the caliber is 16¼ inches, and the barrel 44 feet long, the core having been removed in one piece. The greatest diameter is 6½ feet, and the range about twelve miles. It will fire two shots per minute, each estimated to cost £300. At the trial the projectile, 4 feet long and weighing 2,600 pounds, was propelled by a charge of 700 pounds of powder and penetrated 19 inches of armor, going 1,312 yards beyond the target. It was carried from Essen to Hamburg on a car specially constructed for the purpose. Work is reported as now being pushed forward on several guns of this class, and a number of smaller ones have recently been ordered.

STEEL PIPES.—Steel pipes as a substitute for cast iron now form an important item for the engineer's consideration in the conveyance of water. Such pipes are being adopted for several reasons. As their weight is only about one-quarter the weight of cast iron pipes for the same service, the matter of transportation forms an important consideration. They are also much less liable to fracture than cast iron.

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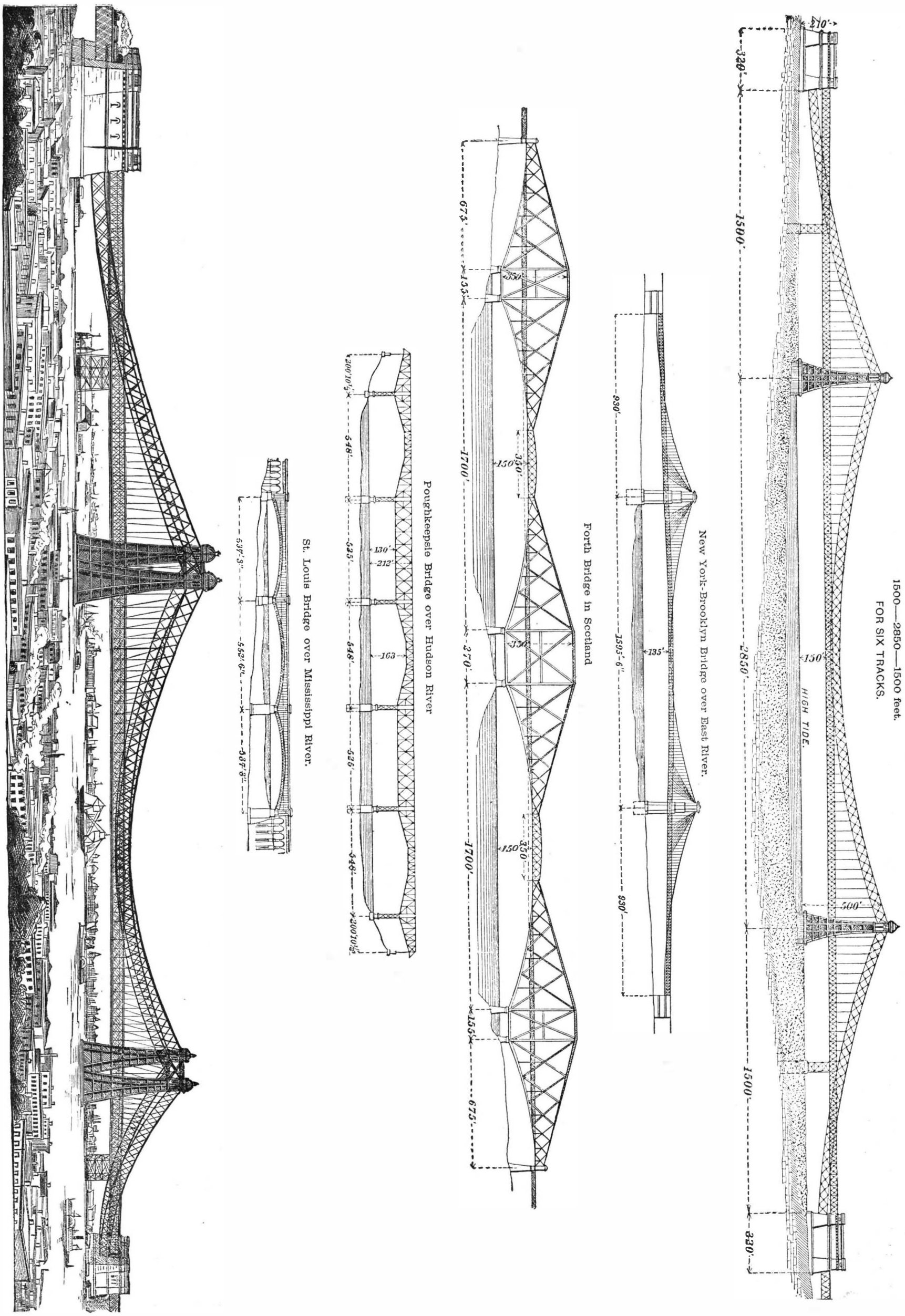
The Traveling Salesman.

A mill furnisher asked the *Modern Miller* recently if the editor could recommend a thoroughly competent man for a traveling agent who did not "bum" around saloons. He said he had become heartily sick of the bumming element among machinery men, and "wanted to secure *one* man, if such a thing were possible, whose expenses would not exceed all the profits on the machines he sold." This mill furnisher has, perhaps, been more than usually unfortunate in his efforts to secure the right kind of men to represent him, but he certainly echoes the sentiments of the majority in regard to that class of men who seem to find it necessary to open a beer barrel or a keg of whisky in every town they visit. It is getting to be a great nuisance. No sensible employer asks or expects an agent to carry a "Sunday school card" around with him, but he does expect that he will not disgrace himself or the house he represents.

THE medal of the Astronomical Society of the Pacific has been awarded recently to Wm. R. Brooks for his discovery of a comet on March 19, 1890. It is the first medal issued by the society.

THE PROPOSED HUDSON RIVER BRIDGE AT NEW YORK CITY.



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Explosive Substances.

BY CHARLES D. LIPPINCOTT.

The following paper was, says *The Pharmaceutical Era*, read before the Pennsylvania Pharmaceutical Association at its meeting in 1886.

SECTION FIRST.—*a. Substances which explode when triturated singly.*—Under this head are to be found only a limited number, among which are:

1. Potash chlorate (commercial), under sharp contusion.
2. Mercury fulminate, explodes with green flame.
3. Mercury nitric oxide.
4. Copper nitrate, dry.
5. Copper fulminate.
6. Antimony fulminate.
7. Gold fulminate.
8. Silver fulminate.
9. Glonoin (nitroglycerine).
10. Hydrogen chloride.
11. Nitrogen iodide.
12. Nitrogen chloride.

The latter three substances and the fulminates are among the most violent of the explosives, their chemical stability being very light.

It may be well to state that in substances which contain carbon, oxygen, and nitrogen, the latter in a more or less feeble state of combination with the whole or part of the oxygen, when the explosion takes place the N parts with its O, which combines with the C, forming CO_2 and CO with generation of heat, and N is set free.

If H be present in the explosion, H_2O is formed in the form of greatly expanded vapor. When Cl is present, it takes the part of the N as from potash chlorate.

We find that nitro substitution for H forms very dangerous explosive compounds, as glonoin, a tri nitro product, also xylodine, a bi nitro, and last, but not least, nitro mannite, a product from manna sugar, and containing six molecules of nitric peroxide ($N O_2$) associated with the carbon of the sugar.

b. Substances which explode when mixed with other substances and triturated:

1. Potash chlorate with acid tannic.
2. Potash chlorate with sulphur.
3. Potash chlorate with antimony sulphuret.
4. Potash chlorate with pot. nit. and ammon. phosphate.
5. Potash chlorate with picrate of ammonia.
6. Potash chlorate with am., sulph., copper and soda hyposulphite.
7. Potash chlorate with picrate of potash produces purple flame.
8. Potash chlorate with picric acid, yellow flame.
9. Potash chlorate with acid oxalic, detonates violently.
10. Potash chlorate with potash permanganate, detonates.
11. Potash chlorate with sulphur and iodine, violent detonation.
12. Potash chlorate with antimony sulphuret.
13. Potash chlorate with sulphur and fulminate of mercury (very sensitive).
14. Potash chlorate with potash prussiate and sugar.
15. Potash chlorate with ammonio sulphate of copper.
16. Potash chlorate with soda hyposulphite, fuses and deflagrates.
17. Potash nitrate, dry carbonate of potash and sulphur.
18. Potash permanganate and tannin, deflagrates.
19. Potash permanganate and picric acid, violent detonation.
20. Potash permanganate, picric acid, and tannin, violent detonation, with yellow flame.
21. Potash permanganate and potash picrate (loud).
22. Potash permanganate, potash picrate, and tannin, very loud.
23. Potash permanganate and potash oxalate.
24. Potash permanganate, potash oxalate, and tannin, violent.
25. Chloride of lime and iodine and iodine resub. (detonates).
26. Dry nitrate of copper and oxalate of potassa, with tannin acid, explodes.
27. Antimony sulphuret, acid picric, and potassa chlorate, detonates with flash.
28. Amorphous phosphorus, acid tannic, acid picric, potassa chlorate, potash permanganate (very sensitive, flashes *without detonation*).
29. Manganese black oxide, picric acid, permanganate of potash, flash, no detonation unless confined.
30. Potassa bichromate, tannin, and picric acid (orange red flash).
31. Potassa bichromate, tannin, picric acid, and amorphous phosphorus, red flash.
32. Ammonium picrate, potassa nitrate, powdered charcoal. Nitric acid with this combination one part, ammonium picrate two parts, and potassa nitrate three parts, forms what is known as *picric powder*.

The following are a few explosive mixtures brought into closer or more compact union by the solvent power of a suitable menstruum; certain component parts, however, remaining in suspension.

33. Indigo, acid tannic, potash chlorate, and amorphous phosphorus, diluted alcohol q. s. to form paste, when dry, is violently explosive, giving off a volume of white smoke.

34. Soda chlorate with golden sulphuret of antimony, very sensitive, emits crackling sounds.

35. Lamp black, amorphous phosphorus, strontia nitrate, tannic acid, spts. turpentine, to form paste, detonates with red flash and white smoke.

36. Substitute dry ammonia, sulphate of copper or dry cupric oxide, for strontia, a beautiful blue flash with loud report results.

37. Starch or dextrine..... 10 parts.
Potash chlorate..... 20 "
Amorphous phosphorus..... 5 "
Water..... 8 "

Mix. When dry produces loud detonation, if confined, evolving copious white smoke.

38. Acid sulphuric..... 75 parts.
Acid nitric..... 30 "
Simple sirup..... 20 "

This mixture is known by name of "Vigorite."

39. Another composed of vigorite, nitrate of potash, and cellulose, is known by the name of "Nitroline."

These two compounds are dangerously explosive.

40. Lac sulphur, golden sulphuret of antimony, valerianate of zinc, chlorate of potassa. This combination has been prescribed and has exploded.

41. Iodine fulminates with turpentine and most of the hydrocarbon volatile oils.

Any of the nitrates will form explosive mixture with combustible substances.

The chlorates, however, part with their O more easily than the nitrates, and in consequence of the strong affinity of chlorine for the metals, chlorine mixtures are very sensible to friction and percussion.

In explosive compounds the elements are all in chemical combination; presenting a definite explosive molecule (*i. e.* containing both combustible and supporter of combustion); hence we can readily understand how an explosive *compound* is more sudden and violent than that of the most intimate mechanical mixture.

Potassium chlorate and all the other chlorates should never be prescribed in powder, mixed with organic and inorganic, combustible, or oxidizable bodies. They should, therefore, when combined, be prescribed only in solution.

The following prescriptions have been known to explode and are dangerous.

℞ Potassa chlorate.
Sodium or calcium, hypophosphite.
Aqua. M.

The two salts should be dissolved separately.

℞ Potassa chlorate.
Acid tannic.
Glycerine.
Aqua.

This should be prepared by making a solution of the tannin in the glycerine and potassa chlorate in the water.

℞ Potassa chlorate.
Pulv. catechu. Should not be dispensed.

℞ Potassa chlorate.
Pulv. gallæ or acid tannic.

SECTION SECOND.—*Substances which undergo or are liable to spontaneous combustion.*—Under this head we find that all compounds that contain oxygen and chlorine, feebly combined with carbon, are liable to undergo spontaneous combustion, by the elimination of O or O and Cl, causing the generation of sufficient heat to inflame the C.

The following comprise those which I have found by experiment and research to undergo this change.

1. Silver oxide and creosote.
2. Potassium permanganate and glycerine. (Spontaneously deflagrates.)
3. Potassium permanganate and acid oxalic. Fuses and deflagrates.

The following prescriptions, under this head, are dangerous; all of which have exploded spontaneously; hence should not be handled by empirical manipulators.

4. ℞ Potassa chlorate.
Tr. chlor. iron.
Glycerine. If warm, will explode.

5. ℞ Potassa permanganate.
Alcohol.
Aqua distil.

This may be dispensed by adding the potassa slowly to the alcohol and water previously mixed, and by dispensing in a loosely stoppered vial.

6. ℞ Oil amber.
Acid nitric; explodes with penetrating odor resembling musk.

7. ℞ Oxide of silver.
Muriate of morphia.
Extract of gentian.

8. ℞ Oil turpentine.
Acid sulphuric.
Should be mixed gradually in an open vessel, as this has caused violent explosions and serious accidents.

9. ℞ Acid chromic.
Glycerine.

May be combined by adding the acid by degrees, rubbing slowly.

10. ℞ Iodine.
Spts. camphor.
Camph. soap liniment.

This evolves nitrogen iodide.

11. ℞ Acid nitric.
Acid muriatic.
Tinct. nux vomica. (Explodes in two hours.)

12. ℞ Potassa sulphate.
Aqua rose.
Tinct. benzoin.

13. ℞ Soda borate.
Soda bicarb.
Glycerine.
Water.

Evolves CO_2, therefore explodes when corked too tight.

In general those mixtures that give off gas should not be corked until the evolution of gas is over. In evidence of the action of the rapid evolution of O in contact with any combustible substance, especially any volatile or inflammable substance, the following affords a good example:

Take of sulphuric acid one fluid drachm, permanganate of potash fifteen grains. Mix in a small mortar. By dipping a glass rod in this solution and touching it to a small quantity of cotton, previously saturated with alcohol, the latter will immediately take fire.

Tobacco.

The amount of tobacco annually consumed in the United States is estimated by an apparently competent authority at 310,000,000 pounds. Seventy million pounds are utilized in the production of domestic cigars; 222,000,000 pounds of chewing and smoking tobacco are consumed; 8,000,000 pounds are used in the manufacture of snuff; 6,000,000 pounds are required in the production of cigarettes; and 4,000,000 pounds of cigars are imported. This would make an average annual consumption of five pounds for every person in the country. But as not more than one-fifth of our population use tobacco, it follows that those who do, consume, on an average, twenty-five pounds each per annum. Opinions differ as to whether this article should be designated a luxury or a necessity. In speaking of the cost of the tobacco habit, an exchange says:

If the tobacco users of the United States would abstain for a period of two years from the chewing, smoking, and snuff-taking habit, and place the money they would spend for tobacco in that period in a common fund, there would be enough money in the fund to almost wipe out the entire national debt, and five years abstaining would give the head of each family in the United States enough money to invest in an eighty acre homestead farm in the far Western States and Territories; or it would give us a navy of fifty first-class war vessels, fully equipped, and create a fund that would man and maintain them and the Navy Department for a period of at least twenty-five years.

It can thus be seen what is the magnitude of the tobacco trade of the United States, and what a multitude of devotees are willing to pay annually for a habit which gives them so much consolation and comfort, if nothing else.—*The Price Current.*

American Universities.

Owing to the great territorial extent of this country, its work in the direction of higher education has taken a peculiar phase. Instead of concentrating itself upon the formation of a few colossal colleges, a great number of smaller institutions have been founded all over the land. This has had an excellent effect in freeing higher education from the traditions of two or three great universities. On the other hand, it is claimed that these smaller institutions are of too low a grade. Recently a movement has been discernible in the same line which has taken the form of re-enforcing the colleges by universities. These are now becoming quite numerous and are of the highest grade. Johns Hopkins University, in Baltimore, the Clark University, in Worcester, Mass., the Stanford University, at Palo Alto, Cal., and a number of denominational universities, all consecrated to post-graduate studies, threaten to give a new aspect to American education. Work has already been done that has won credit for American science everywhere, and more is in the future. The late President Barnard, of Columbia College, was well in accord with this movement, and it is said desired to make his college a post-graduate university. It is certain that for the next generation a liberal education in American institutions will have a far higher meaning than it has had hitherto. The efforts of England and the Continent in the development of the intellectual life of their people, creditable as they are, may yet find a formidable rival here

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The Persecuted Chinaman.

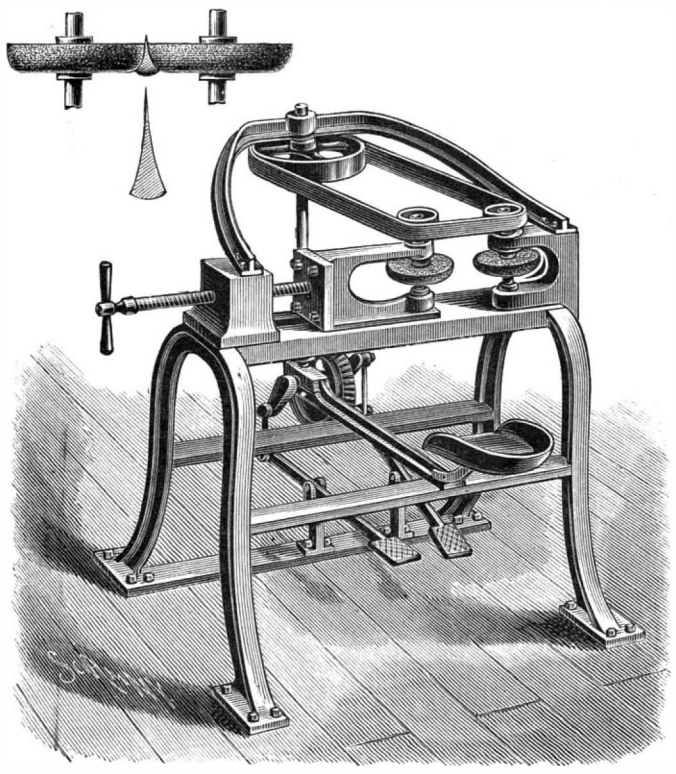
We add our protest to others against the Chinese census bill which has passed the House of Representatives, and is now pending in the United States Senate. This bill requires the Superintendent of Census to give to every Chinaman in the country a certificate, which, after ninety days from the date of the beginning of the enumeration, shall be the sole evidence of his right to remain in the United States, and in the absence of which he shall be liable to deportation or to imprisonment for five years. We are glad to see that the committee of the Senate proposes to omit the clause making the right of a Chinaman to remain in this country dependent upon the certificate. But this is only a mitigation of the wrong threatened by this bill. We do not deny the right of the nation to sift out, or even to exclude by proper legislation, immigrants whose coming the nation believes to be dangerous to its well-being. But, the *Christian Union* says, to select a certain class who have come, and put them under special restriction and requirements and render them subject to exile from the land of their adoption for no crime whatever, is an act wholly unjustifiable and wholly unworthy a great nation. It is difficult, indeed, to conceive even a specious argument for such legislation.

The Action of Water at High Temperatures and at Great Pressures upon Wood and Cellulose.

Pure cellulose gives traces of sugar at the ordinary pressure. At higher pressures the quantity of sugar increases, but at 20 atmospheres it is converted into hydrocellulose. Wood is attacked by water at the ordinary pressure, but the action reaches its maximum at 5 atmospheres, when beech wood loses 26·7 per cent of its weight, of which 11 per cent becomes sugar. There are also produced dextrines, precipitable by alcohol. No vanilline is obtained from the aqueous or ethereal extracts, or from the dried residues. The color reactions of Ihl must be due to the transformation of lignine into carbohydrates.—*H. Tauss* (*Dingler*).

AN IMPROVED GRINDING MACHINE.

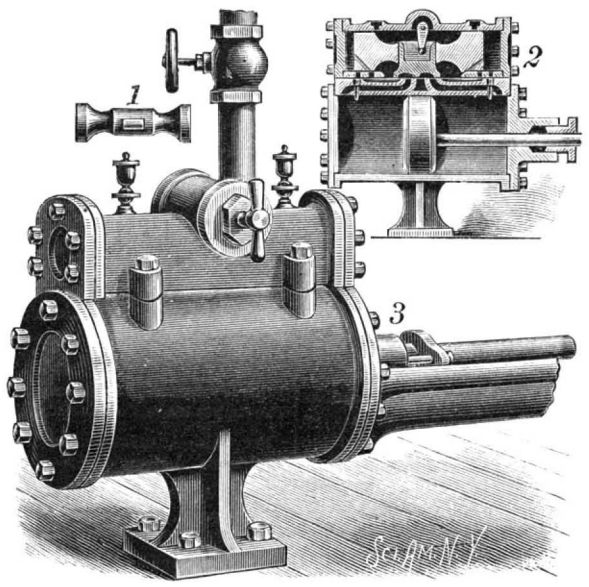
The accompanying illustration represents a machine specially designed for grinding razors and similar articles concave or hollow. It has been patented by Mr. George J. Ridley, of No. 146 Wall Street, Auburn, N. Y. In the top crossbeam of the frame is a bearing supporting a vertical shaft, on which is a grinding wheel with curved periphery. Directly opposite this wheel is a second grinding wheel, the shaft of which is mounted to turn in suitable bearings on a block adapted to slide on the top crossbeam of the frame, toward or from the other wheel. The block is moved with a screw, and is locked in place when adjusted by bolts extending downward through a slot in the top crossbeam. On the upper ends of the shafts carrying the grinding wheels are pulleys, over which passes a belt, also passing over a large pulley on the upper end of a rear vertical shaft, motion being communicated to the latter shaft by a bevel gear and pinion from a transverse shaft operated by cranks connected with treadles. A seat is located in front of the machine in such a manner as to enable the operator seated thereon to conveniently actuate the treadles and hold the articles to be ground in contact with the wheels. The small figures represent the adjustment of the wheels for grinding razors concave or hollow. By removing the treadles and attaching a pulley the machine may be run by power, when, by using a drip to keep the steel from heating, work may be done with great rapidity.



RIDLEY'S GRINDING MACHINE.

AN IMPROVED STEAM ENGINE VALVE.

An automatic valve mechanism for steam engines, designed to be operative without the use of an eccentric or crank, is shown in the accompanying illustration, and has been patented by Mr. William Gehring, of the Standard Iron Works, San Diego, Cal. Fig. 1 is a side view of the valve-operating piston, and



GEHRING'S VALVE FOR STEAM ENGINES.

Fig. 2 a longitudinal section of the cylinder and valve chest, Fig. 3 being a view in perspective showing the application of the improvement. A steam chest on top of the cylinder covers the valve seat, and is provided with a cylinder in which slides the valve-operating piston. The valve seat has an exhaust port, and steam ports which communicate with the ends of the cylinder. To the valve seat is fitted a double main valve, in the back of which is a cavity for receiving an arm on a shaft extending through the side of the valve chest, and provided with a starting lever. The valve-operating piston has a central mortise for receiving the rectangular back of the main valve, and in the heads of the piston are diagonal passages through which steam is admitted to spaces at each end of the steam chest. In the lower part of the valve cylinder are live steam ports and exhaust ports. In the top of the main cylinder, underneath the exhaust ports in each end of the valve cylinder, is a valve casing with a spring-pressed tappet valve, whose stem extends into the path of the power piston, the latter having beveled ends for engaging these valve stems as the piston nears the end of its stroke in either direction. By this arrangement the tappet valves are operated to admit steam to the space at the ends of the valve-operating piston. This valve mechanism, though applicable for general purposes, is particularly designed for use in connection with steam pumps.

Synthetic Indigo.

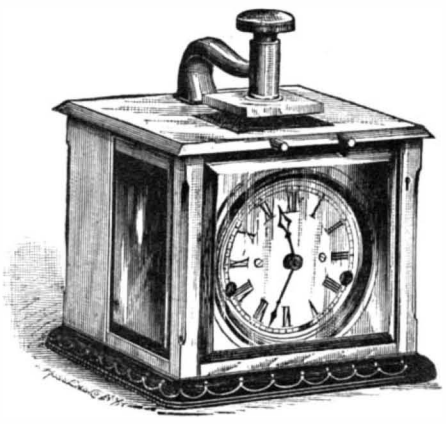
A new and very simple method of synthesizing indigo has been discovered by Dr. Flimm, of Darmstadt (*Berichte*, No. 1, 1890, *Science*). In studying the action of caustic alkalies upon the monobromine derivative of acetanilid $C_6H_5NH.CO.CH_2Br$, a solid melting at 131·5°, it was found that when this substance was fused with caustic potash, a product was obtained which at once gave an indigo blue color on the addition of water, and quite a considerable quantity of a blue solid resembling indigo separated out. The best mode of carrying out the operation, according to *Nature*, is described by Dr. Flimm as follows:

"The monobrom acetanilid is carefully mixed with dry caustic potash in a mortar, and the mixture introduced into a retort and heated rapidly until a homogeneous reddish brown melt is obtained. This is subsequently dissolved in water and a little ammonia or ammonium chloride solution added, when the liquid immediately becomes green, which color rapidly changes into a dark blue, and in a short time the blue coloring matter is for the most part deposited upon the bottom of the vessel in which the operation is performed. The fused mass may also conveniently be dissolved in dilute hydrochloric acid and a little ferric chloride added, when the formation of indigo takes place immediately. The collected blue coloring matter may be readily obtained pure by washing first with dilute hydrochloric acid, and afterward with alcohol."

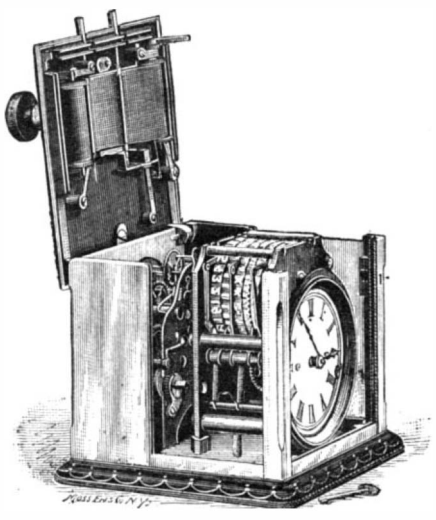
That this blue substance was really common indigo was proved by the fact that it yielded several of the most characteristic reactions of indigotin, such as solubility in aniline, paraffin, and chloroform; its sublimation; and the formation of sulphonic acids, which gave similar changes of color with nitric acid to those of indigotin. The final proof was afforded by its reduction to indigo white and reoxidation to indigo blue by exposure to air. Moreover, the absorption spectrum of the coloring matter was found to be identical with the well known absorption spectrum of indigo; hence there can be no doubt that indigo is really formed by this very simple process.

AUTOMATIC TIME AND DATING STAMPS.

A small compact instrument which is an effective watchman's time clock, and by means of which, by the simple pressure of the hand, the time, date, names, and other designations may be instantly recorded or printed on documents and papers, forms the subject of a patent recently issued to Mr. Charles Stahlberg, of Brooklyn, N. Y. This instrument requires no attention except winding once a week, the month, date, and time of day, to the fraction of a minute, being set automatically at the proper second, including the automatic setting of the first day of a new month from a long or short month, and February of a common or leap year. It is in fact an automatic perpetual calendar, which indicates on paper at any moment the year, month, day, hour, and minute of time on which it is used. The type wheels of the instrument have on their periphery the type corresponding to the divisions of time which each one is intended to print—first, the year wheel; second, the meridian and hour wheel operating mechanism; third, a meridian wheel; fourth, a minute wheel; fifth, a minute wheel operating mechanism; sixth, an hour wheel; seventh, a date wheel operating mechanism; eighth, a date wheel; ninth, a month wheel; and finally, a month wheel operating mechanism. The clock movement is constructed to move the shaft which actuates the type wheel mechanism equal distances at intervals of one minute, or at such intervals as is desirable, the shaft being stationary during the intervals, the intermittent motion of the actuating shaft being gained by the interposition of an auxiliary motor or spring in the train of the clock. This really divides the clock train into two portions, the lower portion of the train being driven by the main springs of the clock, and its office being to wind the auxiliary motor spring once a minute. By this means the power driving the time movement is equalized every minute, and the clock is run under the best possible conditions for the attainment of accuracy. The inking ribbon and mechanism necessary for adjusting it are attached to the hinged cover of the case, giving ready access thereto when the cover is turned back. To guard against picking the lock which opens the stamp, means are supplied to attach a seal. The mechanism, being automatic, can be placed in connection, electrically or otherwise, in



NEW TIME STAMP—CLOSED.



NEW TIME STAMP—OPEN.

police, messenger, and telephone service, with stock tickers, etc., and wherever it is desirable to keep an exact record of date and time to the minute. It is one of the most reliable and effective devices that has come under our notice. The instruments are furnished by the Accurate Time Stamp Co., No. 431 Eleventh Avenue, New York City.

THE question of the best form of meter for registering the supply of electricity to private consumers is being argued in English electrical circles.

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RECENTLY PATENTED INVENTIONS.

Engineering.

SLIDE VALVE. — Edward Leslie, Orangeville, Ontario, Canada. This invention consists of an outer valve having a loose top plate and an inner valve having play in the outer valve, and provided with top ridges on which rests the top plate, the valve being designed to permit of being run at a high rate of speed, and prevent the unseating of the outer valve.

Railway Appliances.

CAR COUPLING. — Martin L. Mardis and John W. Britton, New Lisbon, Ohio (H. Morrow, admr. of John W. Britton, deceased). In this coupling, in combination with a link-securing hook, is a lock bar movable into position to hold the link in engagement with the hook, and a shaft movable longitudinally and connected with the lock bar, with other novel features, whereby the coupling and uncoupling may be effected from either side of the car.

STOCK CAR.—Christopher B. Herman, Norwich, Kansas. This car has a central row of posts, with gates hinged thereto, a longitudinal foot board upon the top of the posts, and braces extending therefrom to the roof of the car, with flexible partitions and other novel features, designed to promote convenient loading, the proper balancing of the load, and the feeding and watering of the stock, and insure its general comfort.

ELECTRIC RAILWAY TROLLEYS. — Franklin C. Wheeler, St. Joseph, Mo. This is an attachment of a tube with a weight, and having a detent for holding the weight in elevated position, a chain or cord being connected with the weight and with the trolley, so that when the trolley jumps from the conductor it will release the weight, thus drawing down the trolley so that it will not come in contact with the upper work and injure the supports of the conductor.

Mechanical.

WABBLE SAW. — Lewis B. Rogers, Mount Vernon, N. Y. This invention is designed to provide a cheap and efficient construction whereby the angle of the saw may be quickly changed and fixed, two bolts being so arranged that one will fit loosely in a hole in the saw plate and bear against the adjoining collars, while the other is screw-threaded and fits a corresponding thread in the saw plate, by means of which the saw is adjusted.

SPRING BENDING MACHINE.—Sobieski L. Bond, Charleston, S. C. Combined with a block adapted to slide transversely is a pair of tongs having two pivoted prongs, one pivoted on the block and the other adapted to press the spring on to the block, with other novel features, the bending taking place while the springs are red hot, and the machine being designed to quickly and accurately bend and set springs to the proper shape.

TRY SQUARE AND PROTRACTOR. — Franklin E. Roberts, Flint, Mich. This is a combination instrument, in which the try square has separate and independent quadrants movably secured to its two members and adapted to be projected beyond the edges, the instrument being capable of many and varied uses by carpenters, millwrights, car builders, draughtsmen, etc.

Agricultural.

HAY RAKE AND SHOCKER.—Wilbur S. Wikle, Indian Creek, West Va. This invention covers various novel details and combinations of parts in a machine designed to be completely under the control of the driver, whereby the hay may be expeditiously and cleanly gathered and delivered without waste to a shocker and packed therein, while the shocker may be quickly dumped and the hay conveniently delivered restored to its upright position.

LAND LEVELER. — John N. Holland, Pueblo, Col. This is a machine more especially adapted for use on such lands as are farmed by irrigation, and has a frame with transverse scrapers at front and rear and a pair of crank axles with running wheels, one at the front and the other at the rear, with a connecting rod and a lever for operating them simultaneously to raise and lower the frame.

RICE HULLER AND POLISHER. — William S. Mallard, Darien, Ga. Combined with a motor is a revolving shaft on which are arranged a series of separately adjustable plates, arranged adjustably in spiral form on the shaft, whereby the pressure and friction can be regulated to remove the outer hull, and also the cuticle or inner skin, and polish the rice.

Miscellaneous.

KETTLE SUPPORTER.—Jacob M. Rohm, Gapsville, Pa. This an adjustable device designed to conveniently support a kettle over a fire, and whereby heavy and large kettles may be raised or lowered while in use as desired, the invention also providing for the support of two or more kettles, and permit of their safe lifting or lowering, as well as their lateral adjustment.

INK ERASER. — William L. Gundlach, Lake Mills, Iowa. This is a device consisting of a double tubular reservoir, in the shape of a pencil, adapted to contain a solution of chlorinated lime in one compartment of the tube and an acid in the other part, whereby the fluid can be applied exactly where it is wanted, and without any excess, to erase one letter of a word or more.

BLIND. — Thomas E. Armitstead, Mazomanie, Wis. This invention covers a novel construction and combination of parts whereby, when the slats are closed, the lower rabbet of the upper slat is brought in contact with the upper rabbeted surface of the next slit below, so that when the blinds are closed their outer faces will be in the same vertical plane, the outer faces of the slats also being in the same vertical and horizontal plane as the outer face of the blind frame.

INK WELL ATTACHMENT.—Dennis B. McAlice, Lincoln, R. I. This is a device for use in the wells of inkstands to supply the pen as it is dipped with a given quantity of ink, and consists of a buoyant pen dip having a hollow air-tight and tubular upper portion, with separated side pieces connecting with the bottom of the cup, whereby the pen will always be supplied with pure ink, but can never take too much.

SAFETY LATCH FOR ELEVATOR DOORS. —John Johnston, New York City. This invention consists of a beaded latch bar eccentrically pivoted, with teeth on its under edge below the pivotal point, a rack engaging with the teeth of the latch bar, and a bow spring contacting with one end of the rack, whereby the car by its movement will automatically unbolt the door, and will automatically lock a closed door.

METALLIC PLATE FOR BOOTS OR SHOES. — Edward Duerden and Joseph Cheetham, Ismailovo, near Moscow, Russia. This is a rotatable annular metallic heel plate, with a filling of leather or other like wearing material arranged within a space between two plates, so constructed as to be supported and secured to the heel of the boot or shoe.

RECLINING CHAIR. — Louis Goetel, New York City. This is a chair in which the back may be made to incline at any desired angle, the invention covering various novel features and combinations of parts whereby the movements of the back may be regulated by the occupant without arising from the chair.

SHOWER BATH, ETC.—Heinrich Schaffstadt, Giessen, Germany. By this invention a water pipe is provided with the usual spray nozzle and outlet faucet, while a steam pipe extends through the water pipe to heat the water, the steam passing in an opposite direction to that from which the water flows, whereby the water for the bath may be heated to any desired temperature.

NEW BOOKS AND PUBLICATIONS.

The *Illustrated American* maintains the high standard of excellence shown in its first number. The purely American character of this magazine entitles it to a place in every family. The photographic reproductions of places and houses of historical association render it of special interest. Some excellent character sketches of members of the United States Senate and House were given in last week's issue. Subscription, $10 per year, should be sent to M. M. Minton, general manager, Bible House, Astor Place, New York city.

SCIENTIFIC AMERICAN BUILDING EDITION.

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2. Colored plates, details, and suggestive floor plans for a residence at Buffalo, N. Y., built at a cost of $7,000.
3. Illustrations of an attractive cottage at Excelsior Springs, Mo., erected at a cost of $1,300 complete.
4. A residence at Park Hill, South Yonkers, N. Y., erected at a cost of $8,500. Perspective and floor plans.
5. Perspective elevation and floor plans of a residence recently erected at Belle Haven, Conn., at a cost of $11.000. McKim, Mead & White, New York, architects.
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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(2152) E. J. F. writes: 1. Distinguish between ball and cone bearings. A. In one case the journal revolves on conical bearings, in the other case it rolls upon a circle of balls. 2. In dissolving yrethane (as used by physicians) I have noticed that the crystals will, after a time, float on the water. They then begin moving about much as if they had life. They jump a small distance, then remain quiet a short time, then move again, and so on. Please explain. A. Surface tension is, we presume, the cause of the phenomenon, as in the case of camphor motions.

(2153) W. R. T. asks: What will bleach ivory after being discolored by age and handling? A. Expose to sun under glass. The direct action of the sun will tend to crack it. Or place on strips of zinc in a vessel, cover with spirits of turpentine, and expose to the sun, not necessarily under glass.

(2154) J. H. writes: 1. My hair has a tendency to curl; will you kindly tell me if there is anything that will help it to curl? A. We can recommend nothing for the purpose. 2. Will you also please inform me which is right? A bets that the National Line of steamers sail under the American flag, and B bets that neither they nor any line of steamers do. A. The National Line of steamers sail under the British flag. No line sails to Europe from this port under the American flag.

(2155) B. L. L. writes: The addition of sodium chloride to a mixture of plaster of Paris and water causes it to set quicker; what is the chemical reaction which takes place? Also when I wish the plaster to set slowly I add potato water (made by boiling potatoes in water), which keeps it soft for some time; how does this affect it? A. There is no reaction in the first case, properly speaking; it is not easy to assign any reason, unless it is the crystallization of the salt. In the second case it is easy to see that the starchy matter of the potatoes might retard the absorption of water, and might offer a mechanical obstacle to hardening by inclosing with starch and organic matter the molecules of plaster.

(2156) D. E. H. asks for a formula to make the amalgam for the friction pads of an electric machine. A. Melt 8 parts of zinc, add 2 parts tin, place 4 parts heated mercury in a wooden box lined with chalk. Pour in the alloy, cover the box, and shake until cool. Bisulphide of tin is highly recommended as a substitute for amalgam.

(2157) E. V. asks: Which is the more generally adulterated—white or brown sugar? A. We should expect most adulteration in the lower grades of sugar.

(2158) S. T. O.—Lack of hair growth in your case must be due to physical derangement of some kind. Better consult a skilled physician.

(2159) F. G. asks (1) the best and cheapest method of making oxygen gas in quantities of from 50 to 100 cubic feet. A. By heating a mixture of chlorate of potash and binoxide of manganese. A gas of fair purity can be obtained by heating chloride of lime. See SUPPLEMENT, No. 314. The heating is to be done in a retort, with proper precautions, etc. 2. What pressure is required to compress 70 cubic feet of gas into a cylinder 10 inches diameter by 30 inches long? A. About 23 atmospheres. We cannot give the reference asked for. Tessie du Motay's oxygen apparatus consisted of retorts with steam and air plant in which the manganate was heated. Air and steam were alternately passed over the heated mass. The air supplied oxygen, which was given off when the steam was passed over it. The Brin process, described in our SUPPLEMENT, No. 623, is the most promising of the large scale processes.

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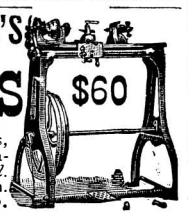

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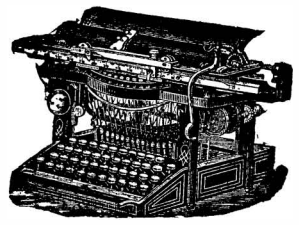

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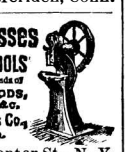

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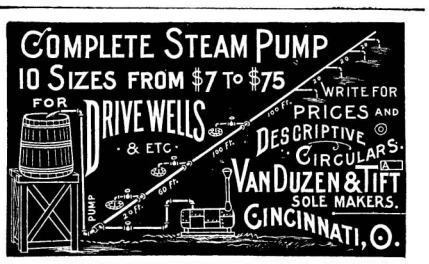

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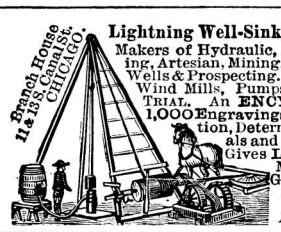

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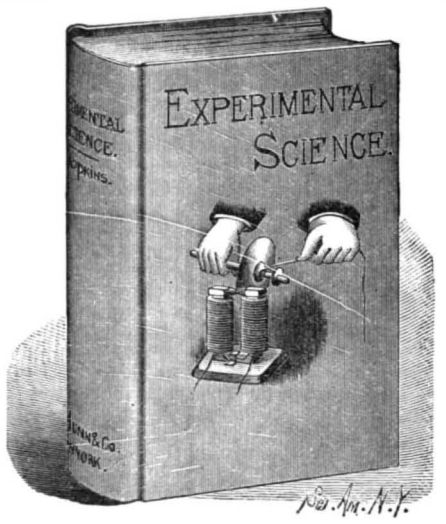

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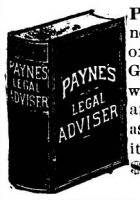

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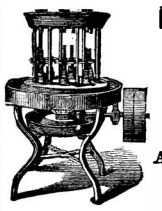

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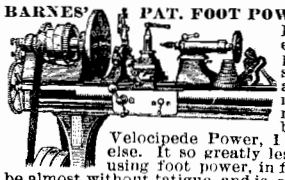

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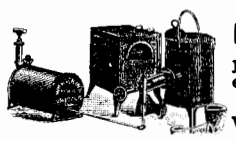

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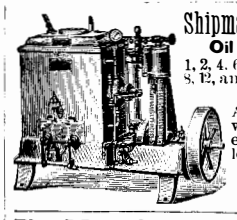

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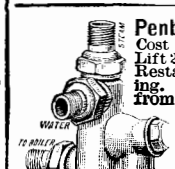

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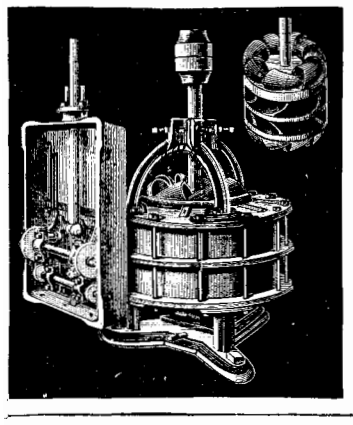

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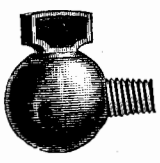

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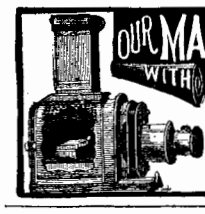

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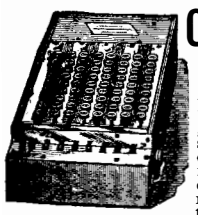

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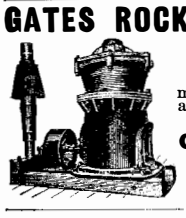

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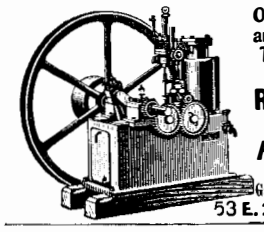

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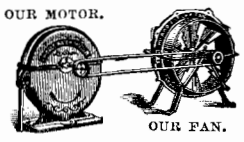

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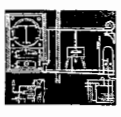

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